

Aviation Week

Including Space Technology

April 6, 1959

Inertial Guidance
System Sales
Show Fast Climb

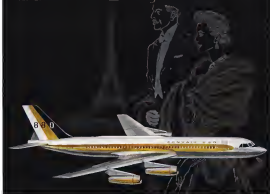
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Modified USAF X-17 Missile
Launches Argus Experiment

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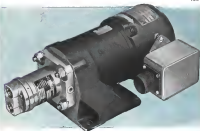
VICKERS

miniaturized motorpumps ...for Vanguard Earth Satellite Rocket Vehicle

Numerous Vickers miniaturized hydraulic *silicone* components have been successfully developed for missile use without sacrifice of their inherent high efficiency and reliability. Representative of the "packaged" approach to dependable missile hydraulic power is the PFM-5504 constant displacement piston type pump shown here mounted on an electric motor. The pump has a theoretical delivery of 0.84 gpm at 7400 rpm and 1000 psi with a volumetric efficiency of 93%. The explosion proof motor has 6.0 in.-lb. torque from 6000 to 9000 rpm. The complete package weighs 8 lb., ... 1 lb. for the hydraulic pump and 7 lb. for the electric motor.

The overall length is less than 10 inches. For further information about Vickers miniaturized hydraulic components and complete packages, ask for Bulletin A-5214.

784



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AVIATION CALENDAR

- Apr. 10—First Annual Radio D. Gordon Lecture** on the History of Avionics, to be delivered by Gordon Lecture, Massachusetts Institute of Technology, Cambridge, Mass.
- Apr. 11—Nuclear Force Arm's World Congress of Flight**, Las Vegas, Nev.
- Apr. 15—17—Second Annual Symposium on Information and Systems Processes**, Purdue University, Lafayette, Ind.
- Apr. 16—17—7th Annual Meeting, Association Training Society**, Denver, Colo., Las Vegas, Nev.
- Apr. 16—18—11th Annual Southwestern Institute of Radio Engineers Conference and Exhibition Show**, Dallas Memorial Auditorium, Dallas, Tex.
- Apr. 20—24—Fourth Institute on Current Developments in Research Administration**, American University, Washington, D. C. Spencer School of Government and Public Affairs.
- Apr. 21—22—Spring Technical Conference in Electronics Data Processing**, Communications Section of the Institute of Radio Engineers, Engineering Society Bldg., Cincinnati, Ohio.
- Apr. 21—23—10th Annual Convention, International Airline Navigation Council**, State Maritime, New York, N. Y.
- Apr. 22—24—11th Annual Meeting, Institute of Environmental Engineers**, (ASCE) Hotel Chicago II.
- Apr. 25—Annual Eastern Regional Meeting, Institute of Navigation**, Friendship International Airport, Baltimore, Md.
- Apr. 25—24—Quarterly Regional Meeting, Association of Local and Forefront Airlines**, Bell Air Motor Hotel, St. Louis, Mo.
- Apr. 27—29—11th Annual Meeting, American Medical Assn.**, Statler Hilton Hotel, Los Angeles, Calif.
- Apr. 19 May 1—First National Minors Engineering Conference**, American Society of (Continued on page 5)

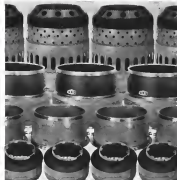
AVIATION WEEK Including Space Technology

April 6, 1958
Vol. 20, No. 14

Presented with an additional issue to *Aviation Week* is the *Aviation Week* Special, a special issue of *Aviation Week* containing the latest news and information on the latest developments in the field of aviation. This special issue is published as a supplement to the regular issue of *Aviation Week* and is available to all subscribers to the regular issue. The special issue is published as a supplement to the regular issue of *Aviation Week* and is available to all subscribers to the regular issue. The special issue is published as a supplement to the regular issue of *Aviation Week* and is available to all subscribers to the regular issue.

Published by the American Society of Mechanical Engineers, Inc., 345 Park Ave. S., New York 10017, N.Y.

AVIATION WEEK, April 6, 1958



precision

ENGINE
COMPONENTS
BY LAVELLE

Precision production of jet engine components is a job for specialists. Besides use of jet-propulsion in helicopters, missiles and drives puts new demands on the high performance small jet engine... and on the precision workmanship required in the manufacture of its parts. "Hot end" components must withstand high stresses and temperatures... require casting, fabrication, welding, machining and inspection... to close dimensional tolerances.

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TRANS-SONICS

Precision Transducers

TRANS-SONICS

AVIATION CALENDAR

(Continued from page 5)

- Mechanical Engineers, Head: Shenton Tye York, Albany, N. Y.
- Apr. 18-May 3—Coastalite Seafloor Co. Inc., American Rocket Society, Miss. (direct), Institute of Technology, Cambridge, Mass.
- Apr. 18-May 1—General Aircraft Meeting, Aerotech, Northrop Assn., Martinsville, Ind., Evans, Pa.
- May 3—Symposium on Electronic Warfare, Phila., Pa. Sponsors: AFCEA/Chapman Division and Electronics and Society (Coastalite Seafloor Co. Inc., 100 Broadway, N.Y.C.)
- May 4—National Aeronautics Electronics Conference, Institute of Radio Engineers, 36 Avenue Hill, Dallas, Calif.
- May 6—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle, Wash. Sponsors: Hughes, Seattle, Wash.
- May 10—Annual Meeting, California Assn. of Airport Engineers, Los Angeles Hill of Monterey, Calif.
- May 6-8—1978 Electronic Components Conference, Benjamin Franklin Hotel, Phila.
- May 6-8—1978 Annual National Forum, American Helicopter Society, Shoreline Park Hotel, Washington, D. C.
- May 7-10—Annual Meeting, National Intercollegiate Physics Assn., University of Illinois, Airport Campus, Ill.
- May 15-16—Spring Meeting, Society of Aircraft Materials and Process Engineers—Eastern Division, Hotel Statler, New York, N. Y.
- May 18-21—1978 Annual National Conference, Society of Automotive Weight Engineers, Head: Henry Gluck, Atlanta, Ga.
- May 20-21—National Spring Meeting & Exhibition, Society for Experimental Mechanics, Sheraton Park Hotel, Washington, D. C.
- May 22-23—Second Jet Age Airport Conference, American Society of Civil Engineers, Sheraton Hilton Hotel, Houston, Tex.
- May 23-25—1979 Ohio Valley Instrument and Automation Exhibit and Symposium, Cincinnati Section, Instrument Society of America, Music Hall, Cincinnati, Ohio.
- May 24-June 3—Federation Aeronautique Internationale Annual Meeting, Moscow, U.S.S.R.
- May 25-27—1979 National Telemetry Conference on Investigation of Space, Space Policy and Communications, Sheraton Hilton Hotel, Houston, Tex.
- May 28-30—Symposium: Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.
- June 6-14—Re-engineered Meeting and Associated Exhibitions, American Rocket Society, 21 Carter Hall, San Diego, Calif.
- June 12-13—24th French International Air Show Le Bourget, Paris, France.
- Aug. 18-Sept. 5—1978 Annual Congress, International Astronautical Federation, Church House, Wigan, Lancashire, England.
- Sept. 7-11—1979 Pittsburgh Flying Display and Exhibition, Society of British Aircraft Constructors, Pittsburgh, Eng.

Space Technology Laboratories is responsible for the overall system engineering, technical direction and related research for the Air Force Intercontinental and Intermediate Range Ballistic Missile Programs and for the highly successful Thor-Able series of space stage re-entry launches. In addition, we conduct our special experimental projects for such agencies as the National Aeronautics and Space Administration and the Advanced Research Projects Agency. On behalf of these agencies and in conjunction with the Air Force Ballistic Missile Division, we designed and produced the Pioneer II payload, one of the most sophisticated free-flying devices ever launched into space. In addition, we provided systems engineering and technical direction for the Air Force satellites, the Atlas scores. In support of these and future requirements, our activities provide a medium through which scientists and engineers are able to direct their interests and abilities towards the solution of complex space age problems. we invite inquiries regarding staff openings in any of the five major areas of the company's activities.

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... employs basic research including analytical and experimental investigations in magnetohydrodynamics, gas-dynamics, power, plasma physics, and low temperature solid state physics.



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... has the overall responsibility for the system integration of the Atlas, Titan, Thor, and Minuteman weapons systems, in addition to responsibility for technical direction of the aircraft sub-system, assembly and test, and ground support activities, evaluate proposed defense response and space systems.



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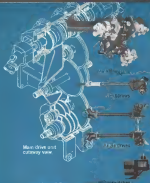
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WESTERN GEAR designs and builds wing flap control systems for **CONQUEST 800**



The newly named Precision Products Division of Western Gear Corporation has launched an intensive program of developing systems for the aircraft industry. Skipped up research, creative engineering, testing and manufacturing facilities put this division in the forefront of the nation's leading suppliers.

Most recent development is the wing flap control system for the Conquest 800 jetliner. Western Gear carried the entire completely integrated system through design, testing and fabrication, delivering the units shown here as well as torque tubes, drive shafts, motors and other components.

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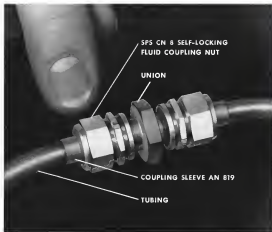
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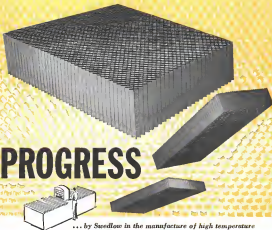
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New free steering, self-locking coupling nut insures vibration-proof tightness—and freedom from leaks caused by nut backset—in fluid system line joints. And the self-contained locking action of this elemental unit eliminates costly techniques in wiring to prevent loosening from vibration. Characteristics are given in Bulletin 218R. Write for a copy today. Aircraft/Missiles Division, STANISLAW PRESTON ETTEL Co., Jenkintown 3, Pa.

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For full information, contact the Swedlow plant nearest you, or write for technical bulletins "High Temperature Welded Honeycomb Cases" Please refer to Dept. 10.

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New improved vacuum
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- Remote control between
modules
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an input constant to ease
data to be converted from
analog to digital
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- Vacuum release on
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Calibration Module	General Purpose	Computer	Low Level Differential	Time Base
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Electro Instruments, Inc.

Master Flight Reference

New General Electric Master Flight Reference System integrates direction and attitude changes; guides supersonic aircraft through intricate maneuvers such as over-the-shoulder and toss bombing

A new navigational subsystem, designed to help solve the problem of integrating the various elements of flight control in supersonic speeds, has been developed by the General Electric Instrument Department. Designated the SR-1 Master Flight Reference System, this electronic "brain" is already being used in guide some of our latest jet in automatic maneuvers such as over-the-shoulder and toss bombing, instantaneous turn, and other-eight.

Basically a direction and attitude reference sub-system, the General Electric SR-1 (Navy designation AN/ASN-26) accurately senses roll, pitch, and yaw change signals by means of three magnetic gyros. These changes are then converted into multiple signals and automatically relayed to aircraft radar, computer, display-screening and navigational computers, landing equipment, and all attitude indicators.

General Electric engineers have designed the Master Flight Reference System around six basic components:

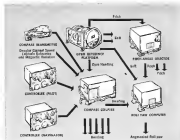
1. A flux gyro, free-gyro, all-attitude stable platform from which flight reference information is transmitted.

2. A small remote compass transducer which furnishes an accurate heading signal and is used in conjunction with the directional gyro platform to provide a matched heading direction.

3. A computer device which receives the attitude signal from the platform, plus any necessary compensating signals from the pilot. Deplier radar and the magnetic compass rendering them to provide an accurate attitude signal with reference outputs for the operation of the system.

4. A control panel located in the pilot's compartment for his use in setting in necessary information concerning mode of operation, aircraft ground speed, altitude, and speed-of-sound of directional gyro and compass. An altitude control panel may be installed for a navigator if required.

5. A servo adapter for platform pitch



output which repeats platform pitch signals for other aircraft components needing attitude information and capable of indicating the operation of any given function at a given pitch angle.

5. A servo control which translates earth coordinates in ground coordinates during control maneuvers. It also provides the attitude roll information for the autopilot and attitude indicator.

The Master Flight Reference System is just one of General Electric's many contributions in aircraft instrumentation. Other G-E aircraft instruments are used in systems that measure and indicate such as fuel flow, engine speed, electric quantities, temperature, and position. For information on any of these instrument systems, contact your nearest General Electric Apparatus Sales Office, or write direct to General Electric Co., Section 296-02, Schenectady 5, New York.

Mechanical, Electrical, Electronic Engineers . . .

If you would like to work on integrating projects such as the Master Flight Reference System, there may be an excellent opportunity for you with the General Electric Instrument Department. For complete details, write or phone for an appointment with

**H. E. Galtman, Manager—
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General Electric Company
40 Federal Street
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GENERAL ELECTRIC

Methods of Carburizing Alloy Steels

Carburizing is a means of impregnating the surface of steel with carbon, usually to very limited depths. Its purpose is to provide a hard, wear-resisting "case," or outer shell. Alloy steels, correctly handled, can be case-hardened without sacrificing desirable core properties.

There are three types of carburizing in general use:

Liquid Carburizing—The medium here is a hot salt bath composed basically of cyanide compounds. The steel is immersed in the bath, the period of immersion depending upon the analysis of the steel and the depth of case desired. Liquid carburizing is a convenient method of producing thin, hard, wear-resistant cases, generally within the depth range of 0.02 to 0.05 in. However, deeper cases may be obtained, the actual depths depending upon economics and end uses.

Gas Carburizing—This method employs a furnace in which a carbonaceous atmosphere is created; i.e., gases that are high in carbon components, or those containing carbon. Steel subjected to gas carburizing can be case-hardened to depths generally ranging from 0.01 to 0.04 in. When quenching takes

place immediately after carburizing, distortion can be kept to a minimum.

Pack Carburizing—Where the pack method is used, the parts to be carburized are buried in a container of dry carbonaceous materials. The container is sealed tight to prevent the infiltration of air, placed in a furnace and kept there for eight hours or more, the actual time depending upon the depth of case desired. Pack carburizing is particularly suitable where a deep case is essential (0.06 in. and over), although medium cases in the 0.04-0.06-in. range are possible.

The carburizing of alloy steels is a highly technical subject, and Bethlehem metallurgists will be glad to help you with any phase of it. Feel free to consult with them about the results to be expected from various analyses and the various methods of treatment. And when you are in the market for alloy steels of any kind, please bear in mind that Bethlehem Steel makes the complete range of AISI standard grades of alloy steels, as well as special-analysis steels and all carbon grades.

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BETHLEHEM STEEL

what is charge?



Earth's attraction for a lightning bolt?

+ or -, which is up?

A resonant phenomenon?

A singularity is a field?

What is the nuclear "glue" for like charges?

A better comprehension of charge is important to Allison because energy conversion in our business and charge is one business for this conversion work. There we have a deep and continuing interest in electronics, physics, processes, materials, materials—charge in all its forms.

In the investigation, Allison calls upon the capabilities within General Motors Corporation and its Divisions, as well as the specialized talents of other individuals and organizations. By applying this systems engineering concept to new research projects, we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapon systems.

Energy conversion is our business



ALLISON

Division of General Motors,
Indianapolis, Indiana

Business Flying's Future

One of the brightest spots in the entire aviation picture is the current growth and future prospects of the wide variety of light operations grouped under the general classification of business flying. The solid expansion in this area during the past five years has paved the way for more significant growth in the years ahead for the entire industry. Road and private flying did not grow, even although neither at the time set in the forecast so widely predicted 15 years ago.

The growth did not begin its significant surge in 1946 on the crest of removing war veterans anxious to buy a low-priced "beaver plane" for fun, instead of a second automobile. Instead it started upward in the early 1950s with the introduction of the light twin engine aircraft with a sales rate rising from \$12,000 up. Its primary customers have been business men—executives, salesmen, operators, doctors, etc., who have no convenient road for readily available fast transportation.

Present Stature

The present status of business flying was well detailed by Erwin J. Bellows, *AVIATION WEEK*, Business Flying editor, in our Mar. 9 issue (p. 149). The benchmarks located there are truly astonishing and worth repeating. A total of 6,416 new private planes sold during 1955 for a total billing of over \$117 million plus—just about four times the market of only five years ago. Business pilots logged 55 million hours in the air during 1955. This represents a growth of 130% in the past decade, accounts for about 38% of all time in the air and a 1.5 million more hours than the scheduled airlines of the U.S. flew in the same year. In addition, the volume of fixed base operations serving this field now is rising at about 5500 hours annually.

All of this has been achieved by some radical departures from prior traditions as virtually every segment of this business—how technical design to financing and sales. The manufacturers have made a good start in building solid sales techniques to make it more attractive and economically feasible for larger segments of the American people to fly their own planes. They are providing dealers and intermediaries with better sales tools and guidance, becoming reality of the automobile industry's proven techniques for financing sales, and recognizing the need for lightweight standards for its dealers, seeking attractive quarters, adequate number of demonstration planes, technically sound service facilities and financial responsibilities. They have also developed more modern financing methods for both customers and dealers with one remarkable financial subsidiary financing over \$10 million worth of new aircraft sales during 1955 and over \$36 million more in operations only three years ago.

Future prospects for this sustained steep growth curve appear to be bright. Federal Aviation Agency Administrator E. A. Quisenberry has been authorized by congressional bills that business flying aircraft sales will total a billion

dollars in the next five years. Instructions flying, which was sagging badly only a few years ago, is climbing back up the growth curve and increased from 1.5 million hours in 1957 to 1.9 million hours for last year. The annual fixed base operations bill will probably double to a billion dollar annual rate by 1962 and close to \$300 million will be spent on research and development for improved performance aircraft for the business flying field.

FAA Recognition

We have also noticed a growing recognition of the importance of this area by the new Federal Aviation Agency. The FAA staff handling the business flying field has been increased and broken down into special units for each of its varied segments. The FAA-sponsored flying in its National Aviation Facilities Experimental Center at Atlanta City scheduled for May 9 is another indication that this new agency plans to devote proper emphasis to this area. We also note that the Air Force is promoting private flying. For example, Strategic Air Command now has private flying clubs at 10 military bases with a total membership of 1,500 military and civilian personnel. The flying club at SAC headquarters now has 17 civil planes and expects to log 5,000 hrs. this year.

Now is business flying activity concentrated solely in the wide open spaces of Texas and California, although these areas offer some of the greatest aircraft use for private aircraft. In the heavy traffic density of the New York, increased use, LaGuardia Field recorded 39,516 private and corporate aircraft movements in 1955, Newark added 28,316 and Idlewild 10,836. All of this was in addition to the 91,855 recorded at Teterboro which is designated as the major center for this type traffic in the New York area.

Growth Poses Problems

This continued growth of business flying poses important problems for all elements concerned—manufacturer, dealer, pilot and owner. As the business aircraft grows, greater utility and performance, pilot standards must be improved commensurately. Proficiency with new equipment and flight control instruments will become a necessary element of a professional license. Fixed base operators must provide better facilities to handle the increasing and maintenance of the growing private aircraft fleet. Manufacturers must provide comprehensive supporting maintenance, performance and safety features in their designs. As the government groups concerned with safety regulations, airport construction and financing, design and operation of airports and traffic control systems must consider the growing requirements of this business flying field and assure it adequate consideration in the overall spectrum of aviation activities.

—Robert Mott

B.F. Goodrich



ANNOUNCING: NEW LIGHTWEIGHT B.F. GOODRICH DE-ICERS FOR YOUR PIPER APACHE

B. F. Goodrich Aviation Products announces a brand new, lightweight De-Icer system for the Piper Apache!

Providing the first practical, low cost ice protection ever developed for light aircraft, this new system contains no moving components. Weight, complete, is approximately 30 pounds—and nearly half of this weight can be removed easily for extra load capacity during summer flying.

The lightweight B.F. Goodrich Pneumatic De-Icer operates on compressed air which is drawn in a compact, constant plastic accumulator. Guaranteed for 49,600 cycles at a 3,000 psi, this accumulator provides enough energy for 7 hours of positive de-icing action with each full charge when operated on a 3-minute cycle.

The system performs satisfactorily between -51°F. and 200°F. Cycle and time life is the same as for the regular B.F. Goodrich De-Icer used on larger aircraft.

A complete kit, fully FAA approved, is now available for the Piper Apache. Contact your local B.F. Goodrich Aviation Products distributor and see how easily you can have your own Piper Apache equipped with this low cost ice protection. Or write B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Dept. AW-49, Akron, Ohio.

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WHO'S WHERE

In the Front Office

Charles A. Ehrenkrantz, board chairman, Palo Verde Corp., National Van M. Ehrenkrantz is executive vice president with the American Airlines Inc.

J. A. R. Key succeeds Sir Rex Deane as managing director of A. V. Roe and Co., Ltd., subsidiary of the Hawker Siddeley Group Ltd. (London, England) & G. J. J. Key succeeds Sir Rex Deane as general manager of A. V. Roe. As managing director of the Hawker Siddeley Group, Sir Rex will continue to be active in the main group.

Donald A. McFadden, president, United States Steel Corp., Cleveland, Ohio. Dr. John T. Bullough, executive vice president, General Motors, Palo Alto, Calif. Dr. E. R. Rabe, executive vice president, Kermel Chemicals Inc., Hawthorne, Calif.

Maxwell H. Hays, vice president technical development and engineering, Laidlaw Associates Inc., Birmingham, Ala.

Jack F. Lingen, vice president industrial aircraft and special projects, Aerojet Corp., Azusa, Calif.

R. E. Tye, vice president engineering, Republic Manufacturing Co., Cleveland.

Donald H. Munn, vice president, Chrysler Corporation, Warren, Boston, Mass., and head of the newly formed Automotive Division.

Stephen R. Elgers and Thomas M. Nolan, executive vice presidents, Bell Aircraft Corp., Buffalo, N. Y. Mr. Elgers is vice manager and Mr. Nolan is vice president of Bell's Nuclear Power Division.

Dr. George R. Kunkel, chief of the new research division of United Research Corp., Menlo Park, Calif., succeeds at United Aircraft Corp.

Honors and Elections

Merle Detsky, French aircraft designer, has received the Grand Aeronautique Society's Gold Medal for his outstanding contributions to the design and development of aircraft.

William Littlewood, American Airlines vice president equipment development, has been appointed chairman of the National Aeronautics and Space Administration's Research Advisory Committee on Aircraft Operating Problems.

Changes

Dr. Adolph E. Thiel, program director for space missions, Ames Technology Laboratory, has been appointed chief of the very heavy division of NASA's Thin Program Office.

Alto White & Brown, and other members, American Defense and Test Development, STL, Dallas, Texas, OGC.

Dr. Arthur R. Kline, executive, General Electric Microwave Laboratories, Palo Alto, Calif.

(Continued on page 125)

INDUSTRY OBSERVER

►Radio Corp. of America has proposed a novel telescoping configuration for an in-flight ballistic missile which can be stored in the North American B-70 in Air Force's WS-110A configuration. Proposal brings the total number of missiles in the configuration to 15. RCA proposal calls for a hybrid guidance system using inertial elements but one which can be reset in-flight and corrected in flight.

►Air Force's Duna-Sort navigation from an operational orbital weapon system is an evolution, partially to test vehicle characteristics of the engine. Vehicle now will be an expected glide, boosted to near missile speeds and altitudes.

►Fought in-flight for the availability of new engines under National Aeronautics and Space Administration's aerial engine development program in mid-1960 for the 6,000 lb thrust engine being developed by Jet Propulsion Laboratory, first month or so of 1961 for the 15,000 lb thrust liquid oxygen/hydrogen engine being developed by Pratt & Whitney, which will be coupled to form a double-barreled second stage for the Centaur vehicle; first quarter of 1961 for the 80,000 lb thrust liquid oxygen/hydrogen engine under study and 1963 for the second 20,000 lb thrust liquid engine under study, and of 1961 for the 15,000 lb thrust single chamber engine under development by Rockwell.

►New Air Force will combine four experiments originally scheduled for Vanguard project but left without launching vehicles due to unsuccessful Vanguard launches. And, similarly, also will combine four left with only one, the quietest vehicles currently used to protect against uncertainties in the duration of the orbit can operate satisfactorily without heavy shields which also reduce the amount of electric power generated.

►One of the most of Navy's Communications Moon Relay is scheduled to go into operation this year taking Washington with Fairchild. Station will be in orbit in a polar orbit. It is now in test and evaluation stage and is expected to provide greater reliability and redundancy capabilities.

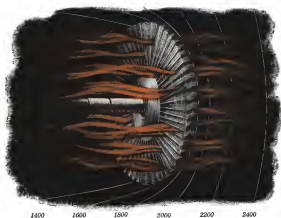
►Polish first ballistic missile launching system can be installed aboard the Long Beach, Navy's first undersea-powered guided missile cruiser. Funds for Polish installations on this and other surface ships may be included in the Fiscal 1961 budget request, depending partially upon results of launching tests from the surface ship Observation Island.

►Despite a delay in Polaris test flights Navy considers that the first phase of the full scale flight test vehicle has demonstrated flight acceptability of the solid propellant and of the light separation system. Tests one of the 24 flight test vehicles had been launched up to the beginning of this year were considered satisfactory success. Failure on the first two full-scale flights were apparently due to elements that will not be a part of the operational vehicle. First failure was of the deorbit system, the second a light program. Cause of the third failure is undetermined. Current delay is due to a large to high temperature problems that are affecting the deorbit control system.

►Navy's ASROC ship-based missile antiaircraft system is expected to be ready for service this early Fiscal 1960.

►Air Force Fiscal 1960 aircraft procurement program includes 78 Boeing B-52H bombers. B-52H is an improved range version of the B-52 to be produced by Boeing Co., Wichita, Kan. Air Force also plans to buy 96 KC-135 jet tankers during the year.

►Army plans to purchase seven or eight Lockheed C-130A dual task and landing transports in Fiscal 1960 for operational and organizational tests. If Army buys the C-130A in quantity, the aircraft will be employed in tactical transport requirements of 16 planes each with one company assigned to each Army and each Army corps.



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Washington Roundup

Nuclear-Plane Query

Rep. Melvin Price (D-Ill.), chairman of the atomic and development subcommittee of the Joint Congressional Atomic Energy Committee and an ardent proponent for pushing ahead with the U. S. industry-sponsored plane program, is planning an inspection tour of the General Electric nuclear propulsion project at Rossford, Ohio, in an effort to find out just how soon this country could put an atomic plane into the air. Defense Dept. would also be expected to participate in the inspection headed by Deputy Secretary Donald Quarles, a long-time advocate of the "jetson" approach.

Proficiency Flying Cut

Under pressure from Congress and the White House to economize, Department of Defense is tightening up on just one "proficiency" flying to desk officers, as predicted by *Airweek* News on Feb. 23 (p. 25). Policies issued by the Department last week direct that such flying "be closely controlled to ensure that the services get the maximum effectiveness for each dollar expended." This provides:

- Annual review of requirements for flying officers and assignment of these officers to positions where they can develop skills and knowledge will be more effectively employed.
- Reduction in total flying activity by combining administrative and support flying as professional training. Previous such flights were conducted in flying time, but not as professional training.
- Annual screening to remove from active flying status personnel who can no longer be expected to fill positions requiring a rated officer.

New Cargo Plane

Meanwhile, Air Transport Area officials and technicians plan sessions with members of the Senate Commerce Committee later this month to discuss Sen. Mike Mansfield's (D-Mt.) proposal for a \$1 billion investment for a fleet of 400 efficient cargo aircraft for military, civil, and commercial use. Mansfield, chairman of the Aviation Subcommittee, is vigorously pushing the proposal. Mansfield suggests that 106 of the all-cargo craft go to the Military Air Transport Service and 306 to commercial carriers to be available for military use on a fee basis basis.

Renegotiation Hearings

House Ways and Means Committee will start hearings on extension of the Renegotiation Act on April 27 with testimony by Renegotiation Board and Department of Defense officials. In a letter to committee chairman Ray Whitby Mills (D-Mt.), Deputy Defense Secretary Donald Quarles says Defense wants:

- To extend the law for two years and three months from the present expiration date of June 30, 1959, to Sept. 30, 1961. In the rapidly advancing aircraft, missile and space fields, Quarles says, there is no past production and cost experience to assist against excessive profits.
- Extension has shown that the renegotiation approach is a difficult method.
- To influence the appeal of renegotiation rulings of the U. S. Tax Court to the Court of Appeals. Aircraft manufacturers urged this last year.

• To require the Renegotiation Board to give "due and substantial" to the general principle of incentive type contracts. A major complaint of aircraft companies is that the Renegotiation Board makes incentive-type contracts meaningless by requiring excessive savings.

• To require Renegotiation Board to its determinations to specifically inform the contractor as to the considerations and comparisons it has given to each of the numerous factors listed in the law—transmittal of costs and profits with regard to volume of production, private capital investment, extent of risk, incentive and developmental institutions, etc.

In Congress

Other Capitol Hill developments include:

- Weapons system. House Armed Services Investigating Subcommittee, headed by Rep. Edward Hebert (D-La.) will begin its evaluation of weapon system procurement on April 11 with testimony from J. L. Arnold, president of North American Aviation, Inc. Arnold will be followed by General Mark Cross, president of Lockheed Aircraft Corp.
- Missile management. House Military Operations Subcommittee, headed by Rep. Carl Albert (D-Calif.) has received hearings with missile management recently scheduled to begin today and is according to write a report weighing Army's "in-house" missile management against management of (USA)'s program by Space Technology Laboratories (AW Mar. 23, p. 34). The subcommittee staff has interviewed several contractors, including General Mark Cross, Lockheed Aircraft Corp., Aerojet-General Corp., and the Aerospace Division of North American Aviation.

• MATS. The Heffelfield subcommittee also is scheduling a hearing on Military Air Transport Service for the first week of May. The subcommittee has outlined MATS for developing services competitive with commercial operations.

• Federal Aviation Agency. House Information Subcommittee, headed by Rep. John Wynn (D-Calif.), is now studying changes that Federal Aviation Agency has suggested on difficulties encountered with the new jet transport aircraft in Lockheed's Boeing 707-120 jet transport.

• Procurement legislation. Senate Armed Services Committee is expected to establish a subcommittee shortly to consider legislation sponsored by Sen. Everett Stubbs (R-Miss.) making extensive changes in procurement law, aimed at cutting back time in new military weapons development (AW Aug. 18, p. 28).

Navigation Dispute Lingers

Despite International Civil Aviation Organization decision to adopt VOR/DME/T in the international navigation system is preferred to the British Government's proposed omnirange system (AW Mar. 2, p. 24), the British can be expected to wage a new legal battle in the days before the controversial matter will be placed on the agenda covering last month's meeting held between President Eisenhower and Prime Minister Harold Macmillan last year. They remained in the recommendation of the Federal Aviation Agency. FAA Administrator Fred Goetz, who has traveled two trips to England in the past six months—including the November trip with Vice President Nixon—is now definitely planning to visit Britain within the next future. —Washington Staff

Sun May Be Origin of Van Allen Radiation

U. S. lunar probe detects new intensity in belts; data indicates inner layer particles are protons.

By Ebert Clark

Washington—Pioneer IV lunar probe, launched after five days of intense solar activity, has shown "almost conclusively" that the sun is the origin of the charged particles trapped in the outermost Van Allen layer in the earth's magnetic field.

The probe detected radiation 2 to 10 times as intense as that assumed by Pioneer III and found the peak of intensity to be 10,000 to 15,000 km farther out from the earth than the peak assumed three months earlier by Pioneer III.

Origin of the particles in the inner Van Allen layer is still in dispute but "in very ingenious past nuclear analysis" of the Explorer IV satellite's flight by the Van Allen group has led to the conclusion that the energetic particles in this inner layer definitely are protons.

There, and a number of other details concerning the two belts of particles spiraling along the magnetic lines of force that surround the earth, were disclosed following a 76-day mission sponsored by the National Aeronautics and Space Administration's Theoretical Division. Formal presentations on the properties of the radiation belts and their geophysical significance will be made at a post-National Academy of Sciences NASA-Astronaut Physical Sciences Symposium here on April 17-19.

Other highlights disclosed at a press conference that followed the seminar at "Solar Van Allen belt" at particles trapped by the earth's magnetic field and occasionally expelled toward earth may explain the origin of the particles found in the outer layer have been established, according to Prof. Thomas Gold of Harvard University. It also may explain the paradox of "the very long times it takes to take the particles to reach the earth as compared to the velocities of energies that we know that these particles have when they get here."

Gold also believes that some process similar to conversion processes in the earth's atmosphere might help explain how the inner

or as a result of the beta decay of neutrons into protons and electrons, as Dr. S. Fred Singer of Maryland University and Christy are inclined to believe. Christy and his colleagues have not excluded the possibility of "very dense gas coming from solar particles." Those who attacked the scenario believed that beta decay impurities could be excluded as far as outer belt is concerned.

"Presence of a substance between the peaks of the two belts seemed to encourage participants to be very difficult to understand," Johnston said. "In other words, you can understand that there is a large concentration of particles left by the sun, let us say. You can understand that there are particles at lower altitudes but beta decay is not clear mechanism indicated why one belt is not changed into the other, but why there should be a gap instead?"

One suggestion was that an irregularity in the magnetic field over South Africa is so located that it might account for the irregularity of the particles. Other theories were that the particles enter the inner belt from the outer belt over South Africa, fall into it. They descend into somewhat lower altitudes than they would if the field were perfectly smooth. At lower altitudes they hit more and more and they get taken out of the radiation layer.

"Space vehicle, traveling at the time of an effective solar outburst, 'caught up' a great number of ions, not only the captured ions, in the earth's field, but far out, far away," Gold said. This would be the case if the sun's magnetic field is focused out in space toward the earth, and the earth happens to pass through a part of the field, in Gold believe, probably. The intensity

SUSAF Drops XF-109

Washington—The Air Force has withdrawn its support from the XF-109 Mach 2.1 VTOL fighter program developed by Bell Aircraft Corp. because of lack of funds. Navy previously had been forced to withdraw from the program (AW May 9, p. 78).

Earlier this year, Bell signed with Convair to build a joint space system management team in push development of the program (AW Feb. 9, p. 21). The two companies now continue development of the XF-109 as a joint company. Funds in stages of funding a new market for the month. Air's conception of the plane, whose initial designation was D-108A, was published in the Jan. 5 issue of Aviation Week (p. 21).



Sikorsky S-60 Crane Makes First Flight

Sikorsky's S-60 crane helicopter made its first flight the day after the United States Division rolled out the Navy S-60 crane helicopter (AW May 10, p. 30). Its first work it had completed 5 hr. flight time. The rotor system and two Part 8 Whitney R5380-10 engines are the same as those of the company's S-60 prototype. Sikorsky to complete its test program and to fly the S-60 to Ft. Rags, N.C. in late work for an Army demonstration. The present day was a full week testing ground. However, the company is testing on an S-60 loaded from the Navy's three boats full test system that would permit using a more wheel action for loading from the sea. The cockpit between a novel window set for the pilot, as that he can have forward in flight or backward in land handling (AW Oct. 21, p. 28). Various turbine engines are in consideration with GE T68 or P6W (T10) frequently mentioned.

detected by a space vehicle might be "as great as the intensity that occurs in form, or even more," and probably would last only a couple of hours. In explanation of this for assumed space flight will not be known until man knows the nature and the properties of the radiation, according to Johnston.

"If the solar origin theory is correct, all effects would be expected to be greater at Venus, which is closer to the sun and is believed to have a magnetic field.

"It is 'very probable' that aurora are caused by the outer belt and 'probably' that the Van Allen layer exists in upper atmosphere. "Saurora" term of a better atmosphere than P. Christy in the Canadian Arctic has been observed. It has been discovered by rocket flights from both locations. Earth's magnetic field traps the trapped particles into the auroral arcs, apparently causing the heating.

Lunar Probe

Pioneer III, an NASA-Army lunar probe first Dec. 6, returned out to 110,000 mi. Its measurements indicated that the radiation belts actually are two belts that extended out from the center of the earth to 60,000 km, and that it had centers on peaks of intensity at 15,000 km and 25,000 km.

Pioneer IV, launched on Mar. 1

following five days of intense solar and solar activity, found little change in the intensity of the inner ring belt intensity of the outer space was greater than Pioneer III's readings by a factor of at least two—an interpretation favored by the Van Allen group—and possibly as high as 10, an interpretation favored by others at the conference. The highest scalar record in the probe did not function properly, leading to the ambiguity.

The probe also found that the peak intensity shifted outward from the earth's center by 15,000 to 15,000 km in a distance of about 15,000 km. It also found that at a point where Pioneer III's data had leveled off into a low intensity per second per unit area, Pioneer IV's data was showing higher fluctuations by a factor of four to 10 over a period of about 10,000 to 15,000 km. The intensity is an extension of the "expected" outer edge of the outermost layer from about 60,000 to about 70,000 km.

Peaks of intensity as judged by Pioneer III were 10,000 counts/sec/sq. cm for the inner and 30,000 counts/sec for the outer one. Maximum count rate about 3,000 at more 15,000 km. Counts are Pioneer IV's flight have not been received in numbers.

Implication is that the magnetic field of the earth drops into the general

note level of interplanetary plasma and fields at about 60,000 to 150,000 km, or about 10 earth's radii, Johnston said.

Outer belt has a strong "soft" solar ion component which probably is electrons of about 50,000 volts, according to the Van Allen investigators. Some scientists also have said as a result of Mendenhall's flight that the outer belt definitely contains electrons in its soft, or low energy component.

Van Allen's group also has found a penetrating component in the outer belt—surface electrons of energy greater than 600,000 volts, or protons with energies of the order of 100 million volts, or greater—but they are in linear numbers than the "soft" electrons.

Inner Belt

In the inner belt, the Van Allen group has definitely concluded that the hard penetrating particles are protons. The softer particles, which are smaller the hard, by 10,000 to 100,000, may be either protons or electrons.

Gold believes that the evidence from Pioneer IV's flight "is very strong" suggesting, if not an absolute proof, that "a solar storm issue and at the earth, feeding back particles into the trapped belts" and having "a little bit of disturbance in the particle content and so the (saurora) field, too, has a few days."

Anti-ICBM Study

Aerospace Research Projects Agency is sponsoring an industry competition designed to find new approaches that can be exploited during the next 18-15 years in delivering incoming ICBMs. Study contracts totaling about \$9 million, are to be awarded to several firms with different approaches to the problem at the end of the month (AW May 2, p. 10).

55

\$5,100 million for Fiscal 1999. Present program calls for a total of 701 aircraft. Ferguson said. The program also provides for nearly 100 jet training aircraft, 10 jet trainer transports and 14 C-130s, plus 40 additional in Fiscal 1999.

• **Nuclear-powered aircraft need.**—Congress said the Air Force needs a nuclear-powered plane to achieve the mission needed to force an enemy's ability in the low-level fight and to increase the efficiency of the airborne alert operations.

• **Multiple processors.**—Gen Ferguson told the subcommittee that new advanced military aircraft must be able to do that category called \$2,000-2 million and will involve a program totaling \$2,701.3 million as compared with a Fiscal 1999 program of \$3,000.3 million. About 55% of the funding provided will be for production and development of the A-10 and T-38 ICBMs and development and testing of the Minuteman. Development, test and evaluation support effort amounts to \$50.3 million.

• **SAGE.**—Program effort facilities of the SAGE early-warning system are now an operation and five more will become operational by end of 1995.

• **Secret base problem.**—Air Force Secretary James H. Douglas, told the subcommittee that the Russians apparently had two and possibly three facilities to force successfully launching a laser pulse over this year (AWJ Jan. 12, p. 35). He said they also have a half dozen in satellite locations.

• **Minuteman bomber.**—Gen Thomas D. White, Air Force chief of staff, said an advantage of the bomber over the ICBM is that it can carry many nuclear warheads and can carry a much longer yield and can carry it can be redeployed. Gen White pointed out. In addition, he said, it has a greater potential for use in limited nuclear war. Douglas said the Minuteman is one of the modern jet bomber and the high yield of the weapons which can be carried, only one independently aimed Minuteman launch is required to assure a 98% probability of achieving a point target, Gen. White said.

• **Other testimony included.**

• **Polish funds for Fiscal 1990.**—Navy Secretary Thomas S. Gates Jr., testified that the Defense Department is negotiating \$400,000,000 in aid to the Polish government for the aid for the Polish nuclear submarine program. The aid is to be provided to the Polish government. The aid is to be provided to the Polish government. The aid is to be provided to the Polish government.

naval communications systems, operation of test ships, operation and construction of support facilities, and training of personnel.

• **Conceptual program.**—Gen Ferguson said the Fiscal 1990 program, Gates said, will be an improved version of the Forrestal class. It will have two twin turret missile-launching systems in the center of the hull and will be capable of operating aircraft weighing up to 64,000 lb.

• **Aircraft ship.**—Gen Ferguson told the subcommittee that the Navy has started what it believes to be the kind of an aircraft ship program that approach more for carrier operations.

• **Fixed-wing Range.**—Fiscal 1990 budget submitted by Navy contained \$326,100 million in new aircrafts. About 55% of the funding provided will be for production and development of the A-10 and T-38 ICBMs and development and testing of the Minuteman. Development, test and evaluation support effort amounts to \$50.3 million.

• **SAGE.**—Program effort facilities of the SAGE early-warning system are now an operation and five more will become operational by end of 1995.

• **Secret base problem.**—Air Force Secretary James H. Douglas, told the subcommittee that the Russians apparently had two and possibly three facilities to force successfully launching a laser pulse over this year (AWJ Jan. 12, p. 35). He said they also have a half dozen in satellite locations.

• **Minuteman bomber.**—Gen Thomas D. White, Air Force chief of staff, said an advantage of the bomber over the ICBM is that it can carry many nuclear warheads and can carry a much longer yield and can carry it can be redeployed. Gen White pointed out. In addition, he said, it has a greater potential for use in limited nuclear war. Douglas said the Minuteman is one of the modern jet bomber and the high yield of the weapons which can be carried, only one independently aimed Minuteman launch is required to assure a 98% probability of achieving a point target, Gen. White said.

• **Other testimony included.**

• **Polish funds for Fiscal 1990.**—Navy Secretary Thomas S. Gates Jr., testified that the Defense Department is negotiating \$400,000,000 in aid to the Polish government for the aid for the Polish nuclear submarine program. The aid is to be provided to the Polish government. The aid is to be provided to the Polish government. The aid is to be provided to the Polish government.

be 100 battleships deployed at overseas bases.

• **Surface-to-air missile.**—Ferguson said the Fiscal 1990 will be lower than either of the two previous years, Gen. Teller said, because of the cancellation of the Rulifone program and the lower level of personnel for ground launching equipment. However, funds are included in Fiscal 1990 to improve Nike Hercules performance against jamming by radar and other electronic countermeasures.

• **Construction of fleet.**—Gen Teller said the fleet program is the fleet program. He said the fleet program is the fleet program. He said the fleet program is the fleet program.

• **Improvement program for fleet.**—Gen Teller said the fleet program is the fleet program. He said the fleet program is the fleet program. He said the fleet program is the fleet program.

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Space Technology

Argus Potential as Weapon Described

By Ford E. E. E.

Washington—Total area blanket of radar and radio communications could be produced from high altitude under a program similar to the Project Argus test of May 23, May 24, and May 25, 1960. The test was conducted in the Pacific Ocean near the Hawaiian Islands. The test was conducted in the Pacific Ocean near the Hawaiian Islands. The test was conducted in the Pacific Ocean near the Hawaiian Islands.

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area above now under construction is the station 10 miles wide and is capable of an area covering in about a surface of 100 square miles in use at altitudes of up to 1,000 mi. without the U.S. knowing it. Other agreements within a year should increase the existing 1,000 mi. to 1,500 mi.

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Detailed Sun Pictures Recorded By ONR Aerobee-Hi Rocket

Washington—First highly detailed photographs of the entire sun, using ultraviolet radiation originating in the outer portions of the solar atmosphere, were obtained on March 31 from an Aerobee-Hi rocket at 425 mi. altitude.

Specialty-developed camera and film which were sensitive only to light of the Lyman-alpha line of hydrogen in the ultraviolet region of the electromagnetic spectrum produced photographs which indicate that such radiation is emitted from spots and patches over the solar surface.

Tests were conducted by Office of Naval Research scientists as part of the U.S. participation in the International Geophysical Year program, under sponsorship of National Academy of Sciences. Rocket carrying the special photo equipment was launched from White Sands Missile Range.

Ultraviolet and X-ray radiation from the sun, originating upon the earth's atmosphere, produces the aurora borealis in the upper atmosphere which reflect radio waves in the high frequency (HIF) band and at lower frequencies used for long-distance communications. Sun spots and other extensive solar disturbances are known to produce disruptions in long-range radio communications and changes in propagation. Scientists also suspect that such solar radiation may play an important role in determining terrestrial weather conditions.

Because this radiation is attenuated by the earth's atmosphere, it has been

impossible previously to make an ultraviolet photograph of the sun from the earth. This had made it impossible to correlate the intensity and location of such solar radiation with the same phenomena as viewed in the visible light spectrum through telescopes.

During the recent experiments, several thousand photographs of the sun were made on the earth using solar radiation emitted at two other wavelengths, the red line of hydrogen and the violet-K line of ionized calcium. Photographs were made at Mount Wilson Observatory in California, the McMurdo Heliotrope Observatories in Michigan, the Air Force Observatory at Sacramento Peak in New Mexico and at Naval Research Laboratory in Washington.

The redline-based Lyman-alpha photographs show the solar weather picture at the highest level in the solar atmosphere yet studied over the entire solar surface, with the calcium-K line mapping the atmosphere farther down into the interior and the red line of hydrogen photos showing the picture still lower in the solar atmosphere.

In continuation, the three will give a three-dimensional picture of the processes taking place in the sun's atmosphere. NRL scientists say. When viewed by the extreme ultraviolet light of hydrogen, the sun appears extremely dense. The same light, extended down also can be seen in the photographs made by ground observations, but are smaller and less conspicuous. This agrees with present theories of increasing intensity of turbulent gas circulation, ionization and ionizing in the stream out of the sun.

Three of these gases are believed to reach the earth. During periods of great solar activity, they produce aurora and magnetic storms and seriously disrupt long-range radio communications.

Through the use of rocketatron over, NRL scientists hope to be able to obtain daily solar weather reports and use them to predict their variation in the earth's weather and radio communications.

The camera used to make the ultraviolet solar photographs was developed by NRL over the last four years. Because ultraviolet radiation is absorbed by air material, a conventional lens could not be used. The camera had to be constructed using diffraction gratings, which function as optical mirrors and direct in just only ultraviolet light rays through reflection.

Special film also had to be developed because the gelatin binder used in ordinary emulsion also absorbs ultraviolet radiation before it reaches the sensitive silver halide grains. Special film used contained almost no gelatin, but this required extreme care in handling to preserve the image.

The camera was aimed at the sun and stabilized against rocket rolling, pitching and yawing motions by means of a photoelectric deviation system which was built at the University of Colorado.

Demand Is Increasing For Avionic Engineers

New York—Demand for electronic engineers may be headed for new peaks, an American Wires staff check of the recent national convention of the Institute of Radio Engineers has revealed.

Recruitment for one company, representing perhaps 25% of those actively recruiting here, American Wires said that this week to have a total of nearly 6,000 engineers during the remainder of the year.

Although most recruits reported fewer job applicants than at last year's IRE convention, nearly all said that the quality and experience level this year is considerably higher. Possible explanation is that many of last year's applicants were men left by industry cutbacks and layoffs, with the latter now sitting tight in the face of uncertainty.

Salary levels are up slightly, ranging from 5 to 10% over last year, most recruits agree, except for much more specialties and experienced men. Engineers with extensive engineering, digital computer and telemetry experience are much in demand, but companies generally are looking talent throughout the electronics field. Some engineers with five years or less experience are being sought by companies such as Aero-nautics Systems, Lockheed and Spacelabs Technology Laboratories in need of their present complement of PE's.

In addition to attracting by individual companies, several employment agencies were active at the IRE convention. One placed many jobs in all areas except hotel phone booths, recruiting applicants to call for job opportunities.

Results of the last day of recruiting won't be known for several weeks. Recruitment is needed in other occupations so whether the situation will get more intense in the coming months. Those who expect demand for engineers to grow point to the increased percentage of research and development required for space technology and the growing number of companies seeking to get into that field.



U.S. Army's 48th Artillery Group first unit equipped with Redstone intermediate range ballistic missile in service abroad, studies the IREI for placement at Fulda, Germany. Newly developed A-1 and Whitehouse techniques, right, raise the Redstone from its transporter.

First Overseas Redstone Unit Trains in Germany



Redstone has its stretch (left) as it goes from position. At right, from its stretch (right) it is lowered. The Redstone unit trained at Cape Canaveral, Fla. (AW June 2, p. 49) in a year before its transfer to Germany.



First ultraviolet photograph of the sun's atmosphere was taken from an Aerobee-Hi weather research rocket fired by Naval Research Laboratory scientists to an altitude of 125 mi. from White Sands, N. M., on March 31. The clouds of hydrogen gas (blue) and ionized calcium (yellow) are shown.



FLOATING while in a weightless condition are Maj. Edward L. Brown, left, and Lt. Michael Gerdner. Lt. Gerdner plays basketball about the other using a compressed air reaction gun.



COMFUSING an action system (left) consists of six helmet bottles strapped to subject's back. At right, test subject plays sports down, on C-119B ceiling, using magnetic shoes.

Weightless Experiments Detailed

Washington—Man can become oriented and feel right side up while standing on his head when he is weightless according to latest findings of Air Force research at Wright Air Development Center. It may be important, however, for man to use a reaction unit or flying belt type of device for individual propulsion in space, the scientists say.

Tests have shown that under weightless conditions a man standing on the ceiling of a jet aircraft using magnetic shoes instinctively feels that everyone else in the aircraft is upside down. This phenomenon has been verified with several different persons during flights in a modified Convair C-119B. Tests were conducted by the Crew Stations Research Section at Wright's Aero Medical Laboratory's Engineering Facilities Branch (AWDB, Vol. 33, p. 55).

These flights along a Kaplanian trajectory leave the aircraft and those in it in a weightless condition for 12 to 15 seconds under normal conditions. Tests that far have shown that magnetic shoes with 7 lb. attraction are not satisfactory for walking on a ceiling but that a 22 lb. attraction per foot is adequate.

A few three individual propulsion units also has been constructed and tested which showed that man will have a major problem in controlling his body attitude and movements as he is propelled from one point to another. Problem is to market that propulsion unit, not that man will have to move about space in some type of scooter or seat on which the man's center of gravity also constantly is line with the center of thrust of his propulsion system. The setup which has been tested at Wright Field consists of six helmet bottles strapped together in a backpack with all the bottles suspended to a base with a handle on the end. The man holds the handle as he has to control direction of the thrust.

One of the most expensive portions of the studies being carried on by the Crew Stations Research Section under Maj. Edward L. Brown concerns the flow of liquids under weightless conditions where pressure head systems do not guarantee the movement of liquids. Tests have shown that liquids tend to move in giant globules where no gravity and bubbles move randomly.

NATO Hawk Delivery May Begin in 1961

Pan-Atlantic production program for the building of the U. S. designed air defense missile, the Army-Hawthorn Hawk, by five NATO nations of west and Europe reportedly will involve 22 battalions with initial deliveries slated to begin by June, 1961.

Final approval of the program by NATO council is expected sometime in April. This will mark the first success of U. S. policy established at the 1957 NATO summit conference. At that session, President Eisenhower proposed NATO nations the U. S. would help establish in Europe large scale production of advanced type weapons.

In addition to the Hawk program, negotiations for European contribution of the Sidewinder surface to missile missile training agreement.

Initially, the Hawk program was aimed at 18 battalions. But France, because of budgetary considerations, has now reduced its participation to ten battalions. While final details still remain to be worked out, the program is already divided as follows:

West Germany, nine battalions; Italy, five battalions; France, three battalions; Belgium, three battalions and Holland, three battalions.

Cost of the program for the five nations involved is estimated at \$440 million. U. S. financial assistance is critical factor for the initial 17 battalions program which is expected to run until 1964 will be about \$40 million over this period.

While the initial Hawk program has been aimed at 22 battalions, this figure may be narrowed to 10 or eight battalions if the U. S. later decides to place all these orders for the Hawk in western Europe. The possibility also exists that European nations involved in the program and in the future consider their participation. Some observers report that in more as 10 Hawk battalions can be supplied by the European program.

European companies involved in the Hawk program are Alcatel de Construction Aéronautique de Charleroi, Belgium; Alcatel, Germany; Finmeccanica, Italy; Philips, Holland; and Thomson Electric, France. Despite increased French participation, Thomson Electric will remain as technical co-ordinator of the group.

Additional European companies will come into the program as subcontractors. It is expected that the U. S. and Germany will pool their efforts, as will Belgium and Holland.

Overall management company for the group, named Societa Europea de Technologie, has been set up in international company under French law.

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Now in production—the world's first space age trainer—USAF T-38 Talon. Mission to train tomorrow's warriors in the art of supersonic flight.

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T-38 Talon is the first of Northrop's new family of high-performance, low-cost aircraft produced at Norair, Hawthorne, California. Using an inherently economical design as a base, Norair management is reducing costs even further by applying three Norair-developed methods.

Free-Performance And Cost Evaluation—a Norair's new way to manage costly effectiveness. Its successful application to the T-38 program has created wide industry and civilian interest.

North's Target Cost Control constantly evaluates all areas of cost—free preliminary design to final assembly. Such a continuing cost of system keeps production costs at a minimum, ensures maximum efficiency.

Years-Ahead Production Techniques utilize Norair's 20 years of airplane experience. In the area of hazycombs structure—for example—Norair designed high-velocity turning, constant rolling, and roll-over, bending techniques from T-38 costs—producing higher quality hardware for less money.

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Pluto Design Proposals Evaluated by ARDC

Washington—Evaluation of three major studies outlining possible future uses of nuclear-powered rocket engines now being conducted by ARDC.

Studies were performed during the last three years by Chascom Wright, San Diego Division of Commerce and North American Aviation's Maize Division. Completion date for the studies was Feb. 28.

Such a vehicle, in its simplest form, would be little more than a flying magnet with the nuclear reactor replacing the conventional combustion engine (AW Mar. 2, p. 38). The payload would be carried in the cylindrical container of the diffuser section of the reactor. Present acceleration information indicates that such a cylindrical vehicle would not need wings to enter at low supersonic speeds.

Thomas Meikle, technical director of the Atomic Energy Commission's Project Pluto which has been pursuing research on nuclear reactors, has testified that these possibilities are feasible with present knowledge and that they may be constructed with currently used materials. Meikle says, "It is not a matter of if, but when it is not."

Present plans at the ARDC to give the Air Staff an early briefing on the possibilities of nuclear rocket vehicles are outlined by the companies which have submitted the design proposals. Air Force Weapons Board composed of general officers, headed by Maj. Gen. James F. Hagen, USAF director of requirements, also will review the proposals and ARDC's presentation.

Controllable Stage Employed in Mechtla

Mechtla—Use of a reusable fuel stage for the next few years is indicated (AW Jan. 12, p. 38) and the ability to reproduce precise trajectory changes of the payload after separation from the final stage appears to require the present version of the payload stage.

A recent article in *Aviation Week & Space News* that "a contract of about \$100,000" out to delivery of 100,000 sq yd was awarded by means of a "special radio electronic system operating at 115.5 mc." Separate transmission operating at approximately 30 mc. was used to telecommunicate back specific data. Article does not indicate how trajectory corrections were produced in payload.

Automatic radio station used and to track Mechtla during the early portion of its flight, but subsequent trajectory corrections were made by an interconnected network of radio electronic stations throughout the USSR.

This suggests that the Russians are using a radio-sonar guidance system similar to one developed in the U.S. by General Electric/Burroughs employing Doppler techniques for guidance of the Atlas intercontinental ballistic missile.

Mechtla's speed at launch was automatically controlled, Provia says, in order to achieve a velocity which would bring the probe into the vicinity of the moon at a time when it could be viewed by "radio means located in the vicinity of the Soviet Union and in other countries of Europe, as well as in Africa and in the larger part of Asia."

Servo Corp. Designs New Omnirange Unit

New York—New type of miniature, ruggedized Doppler VOR which provides accurately updated, accurate over coverage (VOR) in difficult flying areas where there are nearby natural or man-made obstacles will be installed by Servo Corp. of America.

New Doppler VOR is fully compatible with existing airborne receivers without modifications or special procedures (AW Oct. 13, p. 41). Evaluation tests conducted by Federal Aviation Agency at its remotely identifiable stations, also located in Cleveland, S. C., showed over all station error of only 0.9 deg., comparable to that obtainable from conventional VOR at a good site. New type VOR makes it possible to install this station at an optimum location for the air route structure without costly clearing operations.

Lockheed Acquires Seattle Shipyard

Los Angeles—Lockheed Aircraft Corp. has purchased controlling interest in Puget Sound Bridge and Dredging Co., Seattle. The new unit will specialize on nuclear-powered ships and ground support facilities for missiles and their vehicles. Robert E. Gross, Lockheed board chairman, said the shipbuilding and repair division is Seattle's largest (AW Lockheed) a participation in the growing potential of ship construction, modernization and repair for the armed services. U.S. Merchant Marine and other operators.

"With our planned investment in new additional facilities, we believe we may become eligible for a part in building strategic submarines, which are presently are destined to become the capital ships of the future," Gross said. Details of the transaction were not revealed. Except for the planned expansion, no change is contemplated for Puget Sound's management personnel or policies.

News Digest

Gannett Aircraft Engineering Corp. has secured a \$100-million contract for development and production of the Navy A-7F-1 (heaviest attack aircraft) Contract is the first to be let by Navy in a cost-plus-incentive fee system which correspondingly increases or decreases Gannett's profit on a basis of the A-7F's actual over-all performance, as well as on Gannett's control of costs.

North American X-15 high-altitude research vehicle under its second test contract, flying high but with broken wing at an 82-second drop. Flight lasting 1 hr. 45 min. was made from Edwards AFB, Calif. Indications were that the flight was routine, with no complications noted.

West German government's order for 130 St. Albans Avonmouth turbine-gas, oval helicopters brings the company's Avonmouth order backlog to 400.

Subsonic and Western Airlines agree to acquire a quarter share in Aerline, the transatlantic line which is off. A government intervention gave no reason for the decision.

Roman's Alexander Neumayer told the USSR Academy of Sciences there is no doubt Soviet exploration of the moon and planet plans will be achieved by 1965.

Italy and the U.S. have completed formal agreements for the delivery of Super automatic target balloons missiles on northern Italy. Missiles will be trained by Italians with the nuclear warheads in the custody of U.S. personnel. Under the agreement, it will be used as order from both governments before the warheads can be used. Training of the operational troops in Italy will be conducted by Strategic Air Command's 34th Strategic Missile Squadron.

Decision on a contract for operating and maintaining F-100s for the portion of the Pacific Missile Range is scheduled to be made by Navy by the middle of this month. Purchase of the contract will be similar to that of Pan American World Airways at the Air Force Missile Test Center, Cape Canaveral, Fla. British aircraft carrier, *RFA America*, bound for Alaska Corp. of America, Philips, International Tele phone and Telegraph, Lockheed Aircraft Service, Aero-General and Helium & Nitrogen, a West Coast engineering firm.



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their heads still heading economies here and flight planning even when the autopilot is on. The third pilot, or second officer, now performs the traffic watch, though the windows while the pilot pilots are large, and he also takes a pilot's rest when the captain or copilot leaves it impossible. The third pilot also will act as backup for the flight engineer when that someone leaves his station, French said.

Among the other reports to SAE's semiannual meeting was a paper on Eastern Air Lines' Lockheed Electra turboprop, also scheduled for delivery last Friday.

Charles French, vice president-engineering, and introduction of the Electra on Eastern's routes involved considerable concentration of procedures in both operation and maintenance.

Problems of transition are to be expected with new types of aircraft, French said, although many of them could be eliminated by better attention to detail design and "the application of visual logic" during the design, development and testing stages.

More difficulties experienced with the Electra's electrical systems have resulted, according to French from "human" accessories and components such as switches, relays, rheostats and inadequate insulation and connections where the addition of "a few more here and there" would have prevented many failures. In some cases, the Eastern official said, this has been a matter of a "penny wise and pound foolish" policy which the operator often has to correct at this expense.

Eastern had to remove an engine within a few hours of the delivery of its first Electra because of capacitor damage, French said. American and overhead cost over \$10,000. The cost

appears to be a similar object dropped into the engine outlet scoop.

The "greasing gland" of \$10 is of daily operation, French said, would bring to light any weaknesses in design or improper maintenance and stressing instances. The Allison 500-D15 engine, despite more than 100,000 h of operation, engine operation, was not such faced to develop compressor rubbing trouble, but critical system difficulties and accessories failures, French said.

Blips in various Electra systems have been encountered. French indicated more is less in the normal pattern of new aircraft operation. Some of the problems have been minor as nature and crash-repairable while others require a study program to determine the causes.

French and the smoothness and freedom from vibration of turbine engines has accelerated any possible imbalance and amplified vibration effects. This is particularly true of the Electra with a comparatively low power loading and high propeller disk loading, an area of 45 in. diameter between blade tip and hub, he said.

Electra airports were limited recently pending recognition of some vibration problems (AW Feb 25, p. 37).

French said the highest limit, so far, on any of Eastern's Electras is about 700 ft, hardly enough to analyze the experience with each component. Several items, however, must receive his attention, he said. Among them is the engine starting system which requires a ground power unit, costing from \$15,000 to \$25,000 per unit. This he called "an economic waste."

An auxiliary power unit showed the benefit to provide both engine start and electrical requirements might be a solution to his problem, French sug-

gested. Such a unit would not be started prior to landing and during taxi-out until just was activated.

Other problems involving solutions, he said, are provision of resources to compressor and turbine blades and other engine parts, strengthening of the electrical system and its protection against damage, including proper protection against electrical fires. Eastern has gone through its own safety period to achieve aircraft safety without serious incident, French said, "except for departure delays which are under the customer's."

American Selling 45 DC-6s to F. B. Ayer

New York-American Airlines has contracted to sell 45 of its 51 Douglas DC-6 series piston aircraft to Frederick B. Ayer and Associates, aircraft dealer which already has bought 30 of American's Constellation 240s. The latest agreement also gives Ayer first right of refusal for the remaining DC-6s.

Overall value of the last DC-6 sale is \$50 million, according to American. The airline that has managed to dispose of 114 piston planes more than half in fact of 18 months ago. Delivery of the DC-6s to Ayer will be made as the planes are phased out of American's operations, with final delivery scheduled for January 1961.

Included in the DC-6 sale are 80 passenger, 4-passenger and 40-passenger DC-6s, 10-passenger DC-6Bs, and 10 DC-6A cargo airplanes. All the planes will be from two to eight years old. Engines, propellers and airframe parts will be less than \$400,000.

Ayer has bought 10 aircraft over last September and says their purchase value at \$405 million.



AW 650 Simultaneously Loaded Fore and Aft

Twelve tons of freight are simultaneously loaded through door and aft cargo doors of the turboprop. Armstrong Whitworth AW 650 (left) 500 tons of freight are being loaded into the forward door while another ton has not being loaded in the aft door. Controls and instrumentation layout of the AW 650 are at right. Biddle Airline has signed a provisional order for four AW 650s.

Takeoff Power Responsibility Given to Engineers by Eastern

Washington-Eastern Air Lines' flight engineers have been given responsibility for takeoff and climb power settings on the Lockheed Electra in the latest step by the airline to reduce its growing problem of powerplant engine complaints (AW May 23, p. 31).

Estima has been experiencing an increasing dispute between some of its pilots and engineers, in which engineers claim pilots are endangering flight operations and creating maintenance problems by assuming many engineering duties.

Enforcer's premature engine recalls for both piston engine and turbo-prop equipment in January were highly the number recorded for the same month last year. Despite repeated advances to flight crews from the company's maintenance department, premature recalls for February exceeded those of January, which were characterized by Enforcer as "an operational problem of the few aircraft."

Citing a compilation of more than 700 accidents filed by the Flight Engineers International Association with the Federal Aviation Agency, the engineers claim pilot shortcomings with correct flight engineering procedures are the key to much of the current aircraft accident problem. The problem has been most apparent in reports of combustion of engines on takeoff and inability of pilots to maintain correct cylinder head temperatures, they say.

Eastern spokesmen admit the maintenance problems exist and blame them on the agency "could suggest about" of engine operating procedures, but they deny there is any causal connection between the rise in piston/engine assembly and current arguments between pilots and engineers. Private

cure of the trouble. Entire said, however, the expected aftermath of the grounding of flight component during the recent visit by the International Union of Mechanics and the FEIA.

Most of the perennating resources for native eagles have resulted in the Cawson Wright Turbo-Compound engine used on Lockheed H46C and G Composites, the value posted on Company directors calling attention to resources and in flight balance on this perennating air part of a continuing training program the value indicated these were up to monitor species of this cause, Eastern and

Nevertheless, the crisis has specific, who will be the cause that the light company will be responsible for setting bills, taking and check power on the Electric. Its report states that the company will also account transparent and transparency on the Alamos 2012 crisis and points out that the main increase in natural gas, the powerplants specifies there will not be specified in terms of 2012 for natural gas, total increase on 2012 of 4,000 by. Editors reported 19 = light billings of Electric company for this February as compared 20% only 11 for the previous month of this year.

Female removals for poison capture totaled 85 in February, as compared with 55 in January. In flight catchings dropped from 57 in January to 50 in February. However, the decline and the decrease in featherings was due primarily to introduced live maintenance, designed to spot feckly as guests before their fall. Many removals from these specimens have been the elderly changes, all consumption and approaching failure.

If we add cylinder changes to these figures, we have a staggering amount of

trouble and the trend is toward further deterioration," the company told its stock owners.

In a seven page report to all captains, pilots and flight engineers, Eastern spelled out some of its maintenance problems, advised correct operating procedures to avoid further trouble and observed that "it is a matter of need that non-standard and wide varied preferences can bring a major impact to the voice of backseater."

BEA, Aeroflot Sign
London-Moscow Pact

London-British European Airways and Aeroflot will begin the first direct scheduled service between London and Moscow this summer.

The Anglo-Soviet air services agreement drawn up in Echternach was signed last week in Moscow.

BEA says it hopes to begin service early in the summer but not before the middle of May, at the event. No start-up date has yet been agreed upon with the Russians.

Aeroflot's new jet Tu-104 will operate into London Airport under initial restrictions which will be relaxed after sufficient operating experience is gained with these conditions.

BEA plans to begin service with Viscount 806 airliners, shifting to Caravelle 46 jets after flow enters into service in April, 1980. Both airlines are planning to operate two flights weekly in each direction with a stop at Cincinnati.

Other western airlines now serving Moscow include KLM, SAS, Sabena, Air France and from the east, Air India.

Westland Opening
London Heliport

London—London's East Nelson, being built by Westland Growth Ltd, on the River Thames at Battersea, will open April 27.

Traffic handling facilities will start operating the following day, but since the heliport facility is being operated under private license, operators must give brief prior notice of intent to use it, the company says.

Services will include traffic communication and navigation aids, scheduling and towing and parking for its customers' used helicopters. A central administration building will provide passenger facilities. Customs and immigration clearance for passengers and freight can be arranged if your office is in a port.

The company is planning installation of lighting sufficient for landings and takeoffs at night, but the helipad will initially operate during the day.



Comet 4 Claims Intercontinental Flight Record

Fastest flight from England to South America was claimed by 28 North-West Argentinian de Havilland Comet 4 on a delivery flight in March. Elapsed time from takeoff at Hatfield, England, to arrival Buenos Aires was 15 hr, 23 min. Touchdown occurred 25 min later. Distance flown was 7,071 stat mi., average speed was 347 mph.



Western's First Lockheed Electro Nears Roll-Out

First of nine Lockheed Electra turboprop transports being built for Western Air Lines were completed at Lockheed Aircraft's Burbank, Calif., plant. Aircraft will be delivered about June 1, initial service is scheduled for August after delivery of final Electra.

CAB Requests New Legislation To Establish Inspection Rights

Washington—Civil Accounting Board has urged Congress for legislation giving it clear authority to inspect the records and memoranda of defense trade associations.

sums (D-Wash), chairman of the Senate Committee Committee, CAR Chairman James H. Duerke said that although the Federal Aviation Act gave the Board authority to inspect airline records, "there is doubt as to the ability of the Board to examine the books and records of persons controlled by, as an air carrier, under common control with an air carrier, or of service organizations controlled by groups of air carriers."

CAN recently launched a full-scale inspection and review of Air Transport Asia (ATA) Mar 30, p. 47). NTA has not challenged the Board's legal authority to conduct its review.

Other legislation requested by CAB for the first time this year, and supported by Sen. Migration, proposes

- The adverse effects of the pact are particularly evident on the most heavily traded sectors, such as that between New York and Alaska, the Bond and, however, with the increasing importance of the oil market, throughout the country, it may be expected that these practices will go on apace to the expense and advantage of the trading public, unless effective measures are taken to put a stop to them.
- The common pattern disclosed by Bond investigations is far too widespread to make overreaction in anticipation of a heavy trial demand and thus will the society, plus a generous on top, generally ranging from \$5 to \$10.
- Decline a conventional under the

the Department of Defense should not enter into competition with commercial airlines. Airline representatives are skeptical that a policy declaration will be effective in shifting military business from Military Air Transport Service to commercial carriers.

• **Antitrust CME** to regulate the derivatives accounting of its clients — In U.S. district court is a second case—*Alfa Romeo versus CME*—upheld the Board's authority to do this, but the decision was reversed by the U.S. Court of Appeals, and the Supreme Court declined to hear the case.

Noting that depreciation is becoming an increasingly important operating expense for air carriers with the addition of new and more expensive aircraft equipment, CAG said that "improper charges to expense for depreciation would undermine the integrity of the financial statements to exactly the same manner as inaccurate charges for salaries, rents, and other operating expenses of the carrier."

- **Permit the Board to make independent representations in court proceedings.** CAIL was meant to work through the Attorney General.
- **Permit the Board to dispense with hearings in cases where they are not**



Quantas Nears Start of Boeing 707 Intercontinental Service

Quantas Empire Airways, will start Boeing 707-420 jet transport service from New York to London July 29 and to Australia July 31. A Quantas 707-420 also will serve as New York July 29 to Los Angeles, en route to London.

than high-fructose holding patterns. Recurrent reduction in density will cause down components for the increased drag flow rates of jet aircraft during low altitudes at high density terminal rates.

- Turbulence should be used instead of descent in cases where jet transporters cannot be cleared for unrestricted climb.
- Development of advanced approach systems using parabolic leading course-aim will reduce amount of low-altitude holding without reducing acceptance rate of the approach system.
- Push-backing was found to be the most precise method of adjusting approach intervals.
- Graphs was placed on the most for a thorough understanding by operations personnel of critical jet aircraft operating characteristics and limitations to ensure efficient management of jets into the present air traffic control system.

When report noted that simulation tests indicated high speeds of jet aircraft will present a problem to controllers who are not experienced in handling

jets because of higher rates of descent with other aircraft and the low landing rates required for passenger comfort. It added that one of the most important jobs the controller will have will be to become accustomed to "staring ahead of the aircraft" and to the increased operating tempo of jet flights.

The report pointed out that the high rate of fuel consumption will make it desirable for pilots to complete pre-flight checklists prior to starting engines. It also said that "it can become common practice for jet pilots to secure their A/C clearances before leaving the ramp."

In this connection, since jet engines warmup is required for takeoffs, the report recommended a bypass from the job to permit an unobstructed run to landing position. The report said a four engine turboprop, flying at 60 mph, will burn 300 lb. of fuel per minute.

As a means of improving area of each aircraft it is marked sufficiently into the stream of moving traffic the report recommended visibility, weather and passenger departure time to have techniques to be added to the landing and push-backing systems now in general use.

The report was prepared by Paul T. Ansel and Tracy K. Wilkins of the Federal Aviation Agency.

Jet Financing Bill Proposed by ATA

Washington—Legislation introduced by the Air Transport Association to facilitate the financing of jet fleets appears to be now controversial in Congress. The two provisions of the measure would:

- Enable airlines to issue a valid secur-

ity interest in specifically identified properties mortgaged as assets. This may be done at present with respect to engines.

- Facilitate holders of security interests in airplanes and propellers from liability. Holders of security interests in complete aircraft are already exempt from liabilities arising from accidents or other causes in the operation of the aircraft.

At present last week before the Senate Commerce Subcommittee headed by Sen. Mike Mansfield (D-Mt.), J. D. Donnell, assistant general counsel of ATA, said "several" airlines intend to lease jet engines and propellers. "One accident has pointed out that leasing propellers for its turboprop fleet will reduce by \$1.5 million its need for fuel tank loads and is an absolute necessity if its financing of jet equipment is to be encouraged," he said.

Mansfield was unwilling to lease propellers, Donnell said, unless their secure interest in daily and specifically purchased.

Financing agencies are also unwilling to mortgage finance engines or propellers unless they are exempted from liability arising from the operation of the aircraft, Donnell pointed out.

The measure also was endorsed by the National Airline Association, Aircraft Industries Assn. and the General Aircraft and Leasing Co. Board of Directors, representing the leasing firm, proposed an additional pre-condition society holden be perfected from liabilities arising from accidents occurring in the air as well as on the ground. The present exemption, applying only to ground crashes or other surface accidents, should, after the security holder as protection from liabilities arising from surface accidents.

SHORTLINES

- **American Airlines** initiated its Boeing 707-120 transcontinental nonstop New York-Los Angeles flights from two to three daily April 1. The new flight leaves New York's International Airport at 11:45 a.m. and arrives Los Angeles at 2:15 p.m. Return flight leaves Los Angeles at 1:00 p.m. and arrives New York at 10:30 p.m. All times are local. American will begin Lockheed Electra service to Chicago from Washington April 12, with two round trip flights daily, and intends to increase frequency of flights as new Electras are delivered.

- **Northwest Airlines** mailed 138,770 domestic passenger orders February; a 22.6% increase over the same period last year. Total revenue passenger miles flown for February were 108,172,000, up 45.9%. Breakdown for international and domestic passenger miles is 29,407,000, up 14.2%, and 78,765,000, up 49.4% respectively. During February, Northwest showed a net loss after taxes of \$150,127.

- **Pan American World Airways** has mailed 10,000 passenger orders for U.S. and Europe on its Boeing 707-120 aircraft. Only three of Pan American's six jets were needed on the run.

- **Southeast & Western Airlines** has opened new sales office in San Francisco and Atlanta. The carrier now operates on routes to Europe from the U.S., but has applied for permanent scheduled routes from San Francisco/Oakland to the Far East via Honolulu and Pacific Airline has recently been re-evaluated in the Pacific Airline between San Francisco and Tokyo. It carried some 50 million lb. of cargo, and mail passengers on 2,500 flights across the Pacific.

- **Trans World Airlines** flew 255,477,145 revenue passenger miles on its domestic routes during February, making it a 14% increase over the same period last year. TWA attributes much of the increase to the newly opened St. Louis-Memphis route and monthly service on East to West Coast service. During the first week in March, 1,180 persons booked reservations on TWA's flights to Europe for the period prior to June 1—51% higher than the previous week.

- **United Air Lines** flew 344,245,000 revenue passenger miles during February for a 9.7% increase over the same period last year. Mail revenues rose 13% to 2,650,000, freight revenues rose 27% to \$3,330,000 and express revenue rose 8% to \$3,330,000, income rose 21%.

AIRLINE OBSERVER

- **Federal Aviation Agency Administrator Elwood Quesada** has retracted repeated statements, attorneys, because of flight standard checks and improving inspection to tighten up enforcement activities. In an unprecedented meeting in Oklahoma City, FAA personnel were warned against any statement of enforcement of civil air regulations and were given what Quesada calls the "True P" formula as a guide in conducting enforcement proceedings. True P's are fact, fiction, fact and firm.

- **Western, Eastern and Frontier Air Defense Identification Zones (ADIZ)** crossing virtually across the U.S. were discussed last week and flight requirements within the remaining zones were scheduled. Elaboration of the new ADIZs became possible with the complete evacuation of the U.S. border areas with the establishment of an added ADIZ from the Gulf of Mexico to the Pacific. Remaining existing zones are designated Atlantic, Gulf of Mexico, Pacific and Canadian border. Flights now flying in any of the remaining ADIZs will no longer be required to file defense identification flight plans when operating at a true air speed of 150 kt. and 3,000 ft. altitude or less. Formerly, pilots were not required to file a DFR flight plan when operating at 100 kt. below 3,500 ft.

- **Civil Aeronautics Board** has agreed to hold its hearings directed by the president of the Air Transport Assn. on the "indefinite" issue. In its filing to the current CAB review and suspension of the hearings. The Board said it feared it appropriate to hold the hearings in accordance because of an "unqualified statement" by ATA that it would cooperate in the future with the Board in the investigation.

- **Load factor for seven bond service carriers during February** reached 82.3%, an improvement over the 41.9% recorded in the same month last year. Available seat miles for the seven airlines rose from 70 million to 78 million while revenue passenger miles climbed from 29 million to 33 million in the same period.

- **Significance behind the Eastern Airlines' President G. R. Smith** made in 1977 revenues lies in its significant from his current role in make such specific forecasts in question. American, like a number of other airlines, has shown interest in broadening its equity base now that airline stock prices have risen above book value. Since the end of 1959, American's stock has risen from \$14 a share to now \$36, the highest price for American's stock since it split in 1954. Smith predicted revenues would exceed \$500 million, compared with \$316 million in 1976, which should not dampen any market enthusiasm for American's securities.

- **Trans World Airlines** switchedboard operation are now coming off with something of a splash. "Good morning, TWA jets you to California," BOMC is most popular. "Good morning, the jet airline, BOMC." Pan American and American have nothing to say about jets but National dropped it "the cable line." All carriers continue to cling to one traditional opening word: "Recreation or busy, will you kindly soon?"

- **Some of Bureau's transportation** Air-300 airplane transports rate by equipped with computer, taking passengers loading times which will be entered in the baggage compartment near the cabin's forward door for use when the plane is off "unimpaired" airports. The Air-300's high-wing design and low-wing loading permit utilization of much smaller loading stairs than are required for the Tri-Mot, B-1B, or even the prototype B-44.

- **Military Air Transport Service** has awarded contracts to nine commercial air carriers to fly passengers and cargo overseas during April, May and June. Carriers receiving work are Flying Tiger, Pan American, Alaska, Transocean Airlines, Alask Airlines, Capital Airways, United States Overseas Airlines, Orient National Airways and Seaboard Airlines and Western.

Airport Incident

New York—Part of New York Authority's a being used in a 21-year old north and his brother who went to Midwest to see the sight and board themselves exclusively owned by Public Health Officials. The youths left the observation deck at the International Airport Building by an emergency stair, saving by mingling with a stream of arriving international passengers. Since they had been exposed to possible disease infection, Public Health insisted on giving them diets. Their objection to the action is passed at \$6,000 each.

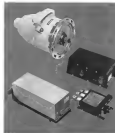
Westinghouse electrical systems, using first brushless generator, proved in thousands of flight hours



NOW IN FULL-SCALE PRODUCTION. The world's first direct brushless generators have a key role in advanced electrical systems provided by Westinghouse for today's military and commercial aircraft. The 40 inch units above are standard in Boeing 707 jetliners. First introduced in 1954 by Westinghouse Aircraft Equipment Dept., Lima, Ohio, these advanced electric generators have performed thousands of flight hours in the Boeing 707 and the Air Force B-58.



NAVY—The North American A3J, completing flight tests preparatory to going to sea, uses the Westinghouse electrical system, including air-cooled brushless generators.



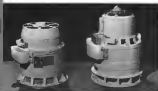
LEADER IN AIRCRAFT ELECTRICAL SYSTEMS. Westinghouse has been providing aircraft electrical systems since World War I—has built more air-circuit systems for aircraft since World War I than any other company. Steps is the brushless electric generator with control apparatus.



AIR FORCE—The Grumman F4U Corsair employs the Westinghouse electric power system, including air-cooled 40 kw brushless generators.



LONGER SERVICE LIFE and greater reliability result from the elimination of commutators, carbon brushes and collector rings, shown at right. A single integral insulator bundle, held by gels, replaces three high-temperature glass insulators, produced by Westinghouse research in semiconductor, make this possible.



BRUSHLESS VERSUS BRUSH-TYPE GENERATOR. Both generate 40 kw. The brushless generator on the left above uses less space and weighs less. Longer life is assured—air-cooled brushless generators are guaranteed for 3,000 flight hours, knowings up to 1,200 hours. Brushless generator with even greater life are under test at Westinghouse.



COMMERCIAL—The Boeing 707 uses Westinghouse electrical system, including air-cooled brushless generators—proved in thousands of flight hours.



ON-COOLED GENERATOR. For Corvus B-58. Butler achieves major breakthrough of temperature barrier in electrical generator design—a cooled by M&S-7008 oil, having inlet temperature of 300° F. Small generator brushes are eliminated—no brushes, commutator or slipring parts in view. Results: greater efficiency, less frequent overhaul.



AUTOMATIC FUNCTION SIMULATOR. One of the newer testing techniques used by Westinghouse, assure more reliable protective devices for electrical systems. This machine subjects protective control panel to as many situations as it will encounter in flight operations.



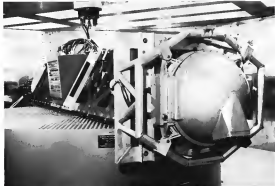
SHORT CIRCUIT TESTER uses punched tape to check capacity of control equipment with 100% accuracy, 60 times faster than previous methods. Westinghouse automatic circuit testing facilities speed production, eliminate chance of human error, improve product reliability.

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YOU CAN BE **SURE**... it's Westinghouse



INERTIAL GUIDANCE system for Ards intermediate ballistic missile, developed by American Bosch Arma Corp., is shown undergoing high acceleration tests on large centrifuge. System at right contains the four stabilized stations, heart of the system.

Inertial Guidance Sales Show Fast Climb

By Philip I. Klein

Washington—Nearly a quarter of a billion dollars' worth of inertial guidance systems were produced last year by U.S. manufacturers and the figure is expected to be 10% higher in 1999, so Aviation Week survey has disclosed (see p. 16). Manufacturers expect to be producing more than 5000 systems annually in inertial systems, the survey indicates.

The segment's remarkable growth in a product which didn't exist a decade ago and which had only begun to emerge from the laboratory five years ago. Figures do not include sales of inertial components, such as gyros, stabilized platforms used for flight instrumentation, stabilization and fire control.

Latest sales figures reflect the fact that internal systems have now become the dominant gateway technique for surface-to-surface and air-to-surface missions and are coming into use for mid-course guidance of surface-to-air and air-to-air missions.

Explanation for the increasing popularity of natural paddocks over modern paddocks is the farmer's complete inaccessibility to corn, panning and transportation. Another reason, in the case of baltic mussels, is the ability to launch most silos and the ease of constructing hardened bases without need for external aid.

Inertial Systems

Inertial systems also are finding increased use in aircraft for bombing and navigation, not only because of their jamming vulnerability but because dies, unlike radar, give no tell-tale electromagnetic radiation to warn the enemy of approaching aircraft. Even interceptor aircraft are being outfitted with inertial navigation to make them more independent of ground-based navigation aids.

At present, fewer than 20 companies dominate the inertial systems field. Only a handful of these hold the bulk of current system production. These include AC Smith, Plex Dynamics of

General Motors, producing for Douglas Thor and Martin Mace missiles, Avco Aero-Bond Arms, producing for Convair Atlas and Martin Titan Ford Instrument, producing Chrysler Radisson and Jupiter guidance. In the jet-propelled field, Sperry is the major producer of aerial bombing navigation systems for the Convair B-58, and Kollsman of vertical navigators for use on interceptors and other guidance aircraft.

These marks will shortly be joined by North America's Automobile Division which intends contracts for initial custom production for the North American Hood Dog air-to-surface missile and for the new USAF Minuteman missile, and by General Electric which will manufacture guidance for New's Polaris intermediate range ballistic missile. The latter system is being developed by Massachusetts Institute of

Technology
Northrop's Northrop Division, one of the first to produce neural systems in quantity for the Space Shuttle, should also be included in the growing list of

[illegible]

though latex production is now tapering off.

The 11 inertial system manufacturers who responded to *Aviation Week's* survey reported a total of \$322 million in sales for 1978, and increased their 1979 sales at \$124 million.

Crestal built 61,000 units of sales for 1983 (total \$532 million, almost three times the 1978 figure and double the 1979 estimate).

Companies which participated in the survey include: AG Spac-Plus, American Branch Arma, Ball Aerosol, Ford Aerospace, International Telecommunications, Knudsen, Loral, Loral Industries, Minneapolis-Honeywell, North American, Astronautics Division, Northrop's Northrop Division and Sperry Gyro Corp.

The survey also touched on other aspects and trends in the bulk of orders now in production and many of those under development as reported by manufacturers or gleaned from other sources.

Aerial system manufacturers were asked to provide the following data on their systems:

- Type: post-central, distributed or Digital control.
- Platform: fixed-wing, four-wheel, four-wheel or six-wheel.
- Type of ground angle and/or dual rate, local/remote, air-to-air or other types of gyro.
- Type of acceleration: non-integration, angle integration or double integration.
- Type of computer analog, digital or microprocessor of both.
- System weight.
- System status in development, prototype or production.

Remote accuracy is considered classed as 100% if it was not requested of five manufacturers.

The bulk of current guidance systems are pure optical, except for the Non-rotary Infrared Inertial system used in the Northrop Star II, for survey vehicles.

For ballistic guidance and lag, aircraft which normally are equipped with strapdown, a three-gimbal platform generally is used, the survey shows. On monostatic aircraft, however, the terms being developed by Honeywell and Loral employ four-gimbal platforms to avoid the problems of gimbal lock under 360-deg pitch or roll maneuvers.

On the other hand, strapdown platforms being used in the Kermath platform for the Lockheed F-15H and General F-105.

'Strapped-Dow' Systems

New "strapdown" inertial systems, which do not use artificial platform (no-gimbal), are being developed by International Telecommunications and Sperry Gyro Corp.

This approach eliminates mechanical complexity and weight at the expense of more sophisticated computer code to perform the dynamic compensation required for acceleration sensed



DC-8 uses newest G-E silicone rubbers



RTV compound used for sealing and sealing RTV (room temperature vulcanizing) silicone rubber seals without the application of heat in any time you select up to 48 hours. It won't crack (no solvent), forms on words RTV has excellent bond strength—plus resistance to high temperatures (about 500°F), moisture, weathering, acids, alkali, fuels and solvents. Tough, strong, good electrical properties.



SE-555 silicone rubber gaskets are used (shown) and built. SE-555 has substantially double the strength of ordinary silicone rubbers. It resists, maintains resistance to weather and temperature extremes (—150°F to 300°F) with high tensile and tear strength. It's easily fused only in organic rubbers. SE-555 meets ASTM 3555 standards and can be fabricated in any color, including white.



For all that of stress-tough-reinforced Class 700 silicone rubbers with flexible retention of some material. (Each sealed with General Electric RTV.) Butts of G-E Class 700 silicone rubbers have a service range from —100°F to 400°F and in other applications carry air up to 300°F. They resist stresses against both and lubricants have low compression set, and will not "cold flow" away from clamps.

For application data on G-E silicone rubbers, write General Electric Company, Silicone Products Dept., Section B734, Waterford, N. Y.

GENERAL ELECTRIC

Silicone Products Dept.

Waterford, N. Y.

accelerometers attached to the vehicle. One system of this type being developed by ITT is expected to weigh 75 lb., another is expected to weigh only 45 lb., the company says. Ford Instrument has given no details on its system.

In aerial system comparisons these appear to be a head toward digital types, although analog computers perform better in current production, Avionics World's senior designer.

A digital computer is mandatory for the strapped-down type inertial system because of the computational accuracy required.

The single-unit liquid-fueled integrating gyro clearly dominates the aerial system field. However, Ames, Bell Aircraft and Latham Industries use the two-unit displacement type gyro and are present main arguments for their choice.

Ford Instrument employs single-axis air-bearing gyros, developed by Avionics Research Aircraft as an outgrowth of Avionics gyro design developed during World War II. North American also has done extensive work on air-bearing gyros but does not disclose any details on its inertial system.

In the area of accelerometers, the field is almost evenly divided between non-integrating and integrating devices. Most systems using non-integrating accelerometers also employ digital computers which can perform the required integration function in addition to their other duties without significant increase in computer weight or complexity.

Smaller and More Accurate

A comparison of the weight of systems now in production with those under development today reveals the significant size-weight reduction that has been achieved in the past several years even though direct comparison is difficult unless system accuracies are known and comparable.

Useful systems of a decade ago weighed 1,700 lb., occupied 75 cu. ft. of space, had an accuracy of around 1 foot mi., and a mean-time-to-failure of only 50 hr., according to Fairchild Systems of Minneapolis.

Today's inertial system weighs about 100 lb., occupies 3 cu. ft. of space, has an accuracy of about one-tenth of a foot and a mean-time-to-failure of about 1,000 hr., Stevens says.

An Air Force spokesman at Wright Air Development Center's Weapons Guidance Laboratory estimates that industry has achieved a 18:1 reduction in inertial system size and weight in the past several years. He predicts a significant, but not quite so large, reduction in the next several years. But by then further gains will be difficult.

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Now you can break the time barrier—inter-plot an coast-to-coast—of inter-plotting any kind of visual data as values. With a Fairchild facsimile communication system, plotted to serve your specific needs, you can transmit engineering drawings, change orders, blueprints, charts, sketches, airmail, schedules, specifications, photos, forecasts, reports, shipping orders, forms, letters. You can use short wave radio, telephone, leased wire or microwave transmission. You can transmit data rapidly and dependably, without error, and with the sharpest detail available today.

Aircraft industry applications

Norfolk Aircraft, for example, uses Fairchild Facsimile to save valuable time in transmitting engineering data between Hawthorne, Calif., and Cape Canaveral. Douglas Aircraft, in fact, uses facsimile between Santa Monica, Long Beach and Edwards Air



Force Base in California. Ends Fairchild Facsimile's extensive clarity of speed benefit. Often, on receiving change order transmits, an operator will make small out-of-focus lines and transmits them to another point.

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Operation? Just attach the plug, on the sender, press a button, and in less than 4 minutes transmission is completed at the receiving end. Reliability? It has served the demanding needs of the newspaper industry for over 20 years. Service? Fairchild offers an established nationwide organization, unqualified in this field, that includes 50 experienced service specialists. Cost? An attractive lease arrangement covers preventive maintenance, periodic equipment updating, and equipment repairs as needed. Available as developed. Full information, and coupon now for literature. To Deliver the Facts... Fast.

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CONVAIR 680 DOOR SEAL

Fourteen stainless steel service bolts of the "H" surface will be sealed under pressure. Right cushioning by the Convairec support, self-energized, half-discharge seal manufactured by CHR. This new seal is composed of high tear resistant silicone rubber, standard with dacron fabric. An inner and outer pressure wall, a full axle feature, precludes loss of pressure in the event of seal failure. The Convairec seal support is integrally molded within the seal to eliminate the possibility of collapse. This flexible spring steel wire supports the side walls of the seal when produced and ensures positive alignment with the leading edge. This unique design, not found in conventional door seals, was recommended by the original "H" plug type door structure.



View how the door seals the plane. Support bolt. This point can get a good seal at any angle of rotation.

The Convairec seal, shown in operation.



CHR specializes in the production of air frame and engine seals for -100°F . to 600°F . applications. Our field representatives are available for direct contact. Write or phone CHR today.

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to achieve other major achievements are needed in developing fundamentally new types of guns and accelerators.

This is one reason why the Weapons Guidance Laboratory is sponsoring research in what is known as "active" inertial components. Current progress includes investigation of the possibility of a subsonic spin gun at General Precision Laboratory, a crystal spin gun at Caltech Industries, and another program at the W. L. Maxon Corp. Progress in the General Precision Laboratory program has been "fairly promising," in fact, a spokesman says.

One of the most challenging problems for imaginative engineers and physicists is to come up also with fundamentally new approaches for issuing instructions.

Study of the stabilization and acceleration sensing mechanisms which nature has designed for insects, is a valuable analogy. But the head of a pin may provide insight into basically new approaches for stabilizing inertial components and/or improving their accuracy. The vibrating gyro developed by Sperry Gyroscope Co. several years ago reportedly was inspired by the inside balance (vestibular organ) of the common housefly which are used to provide a form of gyro stabilization.

Future Guidance Systems

Inertial systems, in conjunction with extensive star/placer radars, appear likely to play the dominant role in interplanetary space navigation. Here, however, the inertial system's primary role will be to provide spatial stabilization for the star/placer radars to keep them approximately aligned on the body.

Several major aerial system producers already are developing technological systems for such applications.



Multivibrator

Microcathode multivibrators, fabricated naturally from a single silicon crystal, is one of several solid-state circuits produced by Texas Instruments (AIE May 18, p. 11) in part of its molecular electronic program.

Klixon Precision Thermostats HELP ASSURE DEPENDABLE, SAFE OPERATION OF MANY BOEING 707 COMPONENTS



In dependent high-altitude operation, the Klixon thermostat is used to control the engine oil temperature and the engine oil pump oil pressure.



Boeing 707 Jet Engine

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For example, on the cabin air heaters produced by AirResearch Manufacturing Division of The Garrett Corporation, Klixon Precision Thermostats assure positive temperature protection... contributing to better safety and dependability. These heaters are lightweight units which fit into the 707's main cabin air conditioning ducts where they sense incoming air to proper temperature. The thermostats shut off the main power source to the heaters as a safety precaution in the event temperature exceeds the limit value.

Klixon snap-setting controls are ideal for applications of this type — for several important reasons. They are small in size and light in weight; they respond to temperature change quickly and with accurate repeat performance; they have simple capacity to carry electrical loads as required; and their calibrations stand up in the face of severe environmental conditions.

Let qualified Spencer engineers assist you, too, with your temperature control requirements. They will be pleased to study your application and, if a standard Klixon Precision Control is not suitable for it, they can recommend adaptations to operate at present your particular equipment. Write today for the Klixon Precision Thermostat Catalog. Choose Klixon Controls with confidence.

Western manufacturers — refer inquiries to Metals & Controls Corporation, Southern California Office, 322 North Lake Avenue, Pasadena, California... Telephone KY 4-4558.

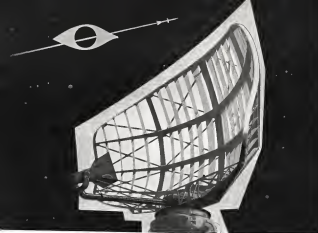
METALS & CONTROLS

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.....THE WHITES OF THEIR EYES.....

The whites of the enemy's eyes are now visible halfway around the world—thanks to technological contributions from Stavid in the area of long-range radiofrequency detection and high-power radars.

When it becomes operational, the high-power Early-Warning Air Search Radar now being developed by Stavid will greatly extend the vision of ships in our DEW-line defense network. Innovations in radar transmitter design will provide a compact, high-power system, achieved through new techniques in tube fabrication and assembly.

Every new advancement in long-range detection Rad Stavid in the vanguard, working with yours as well as state-of-the-art techniques.

OTHER STAVID PROJECTS INCLUDE:

- Short-Range System (AMFMS)
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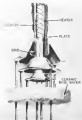
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Imaginative Electronics...

Outstanding engineers and scientists are invited to inquire into opportunities at Stavid's advanced systems engineering teams.



Arthur A. Kasper, Jr., Stavid systems engineer, is Stavid's lead engineer in advanced and microwave development. He works on Stavid radar systems for air search, guidance, intercepting and air-borne tracking.



SCHEMATIC drawing showing Nuvistor construction is at left. Three types of Nuvistor that RCA is presently developing are seen at right with conventional vacuum tubes. They are (left to right) a small signal triode, small signal pentode, and beam power tube.

Tube Designed to Compete with Transistor

By JAMES A. FARR

New York—new design concept for electron tubes may broaden the competition between tubes and solid-state devices. The design approach is said to make possible tubes the size of thumbtacks that are more reliable and provide higher performance than conventional electron tubes.

Called Nuvistor, these new tubes are under development at the Radio Corp. of America's Electron Tube Division. At present three different tube types are being studied for simple electronic uses within the next few months: a small signal triode, a small signal pentode, and a beam power tube.

The design is the result of efforts by RCA tube engineers to meet the increasing requirement of microelectronics in both the commercial and military receiving tube market. A further consideration was that sufficient order in size and power class in a tube that could be mass produced, coupled with increased performance and reliability, could compete at some future time with the solid-state transistors now in common use.

Development History

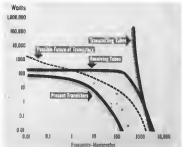
RCA engineers describe the Nuvistor concept as the result of a general study and development program studying a new approach to electron tube design.

In the course of the program, glass structures, cylindrical structures, ceramic spaced stacked structures, metal to glass seals, metal to ceramic seals, and similar items were explored.

Plasma tube elements, because of the apparent ease with which they could be assembled, was one area that was carefully investigated. It was found, however, that an advantage in assembly technique was offset by disadvantages in electrical and thermal characteristics. The concept of advanced properties for receiving tube structures, however,

gained increasing support. It offered electrical and thermal efficiency and stability, and could be manufactured easily and economically.

The design that resulted from the study explores ceramic cylinders supported in an open-ended container structure. These cylinders are held in place by tripod-like structures that are



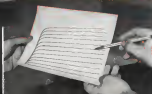
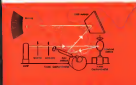
POTENTIAL of electron tubes is compared with that of solid-state devices in chart above. Small curves represent performance of experimental transistors now being developed. RCA sees Nuvistor as reducing area of competition between tubes and transistors.

100 CPS X-Y RECORDING

with immediate
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THE NEW SANBORN MODEL 670 OPTICAL X-Y RECORDER HAS

- ★ 1% linearity
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3 db down at 130 cps
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PLOTS OCCUPY AN 8" x 8" RECORDING AREA and can be previewed or monitored on the instrument's phosphorescent screen. An Auto Record switch to plot X and Y axes on the record, and a Beam Intensity Control to assure maximum trace clarity, are among the front panel controls provided. An 8" x 8" sheet of the ultraviolet-sensitive chart paper (stored in drawer at base of cabinet) is easily placed on the back of the hinged screen. Real post exposure in normal room light is the only developing process.

OPTIONAL INTERCHANGEABLE PREAMPLIFIERS for each axis presently include the Model 450-13000 DC Coupling and Model 600-1300 Phase Sensitive Demodulator; a Corner Preamplifier, High Gain Preamplifier and a Time base generator are now in development. Driver Amplifiers are compact, fully unbalanced plug-in units with single-ended input and output. Galvanometers are low maintenance, low voltage units of rugged, enclosed construction, sensitivity and damping are independent of cell temperature. Adjustable, oil-filled venting also extends to the power supplies—a front-panel plug-in for both preamplifiers and a second supply for both driver amplifiers. A built-in blower provides constant, forced flow of air cooling. The Recorder can be rack mounted in 13 1/2" of panel space, or housed in its own 20" x 20" x 21 1/4" optional portable cabinet.



Ask your local Sanborn Sales-Engineering Representative for complete information on the Model 670 X-Y Recorder, or write the Industrial Division in Wellesley, Mass.

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MISSILE TRACKING

SEA-LAB



This huge antenna is part of an electronic and optical system that RCA installed and is operating on the S.S. American Mailer. The purpose of the equipment, for which the ship has been refitted, is to provide the most precise data yet obtained at sea on missile flights over a range extending from Cape Canaveral, Fla., to the area of Ascension Island. The project is

sponsored jointly by the Advanced Research Projects Agency, Department of Defense and the Army Ordnance Command. A scientific staff—most of them RCA personnel—will operate the equipment and report on missile performance from descent from space to final plunge; the data to be shared by all branches of the armed services.



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► **Minimizing Radar Detection**—New technique which partially compensates for radar detection of radar look-alike in missile guidance system has been developed by Chao Shun Unanishi's Electrical Engineering Department. Technique bears some similarity to self-adapting technique now being developed for automatic flight control system (AW Tech 9, p. 59). Project, headed by Prof. Robert Conrad, is sponsored by Wright Air Development Center's Weapons Guidance Laboratory.

► **National Telemetry Symposium**—Call for prospective authors of individual papers has gone out for National Symposium on Telemetry, to be held in San Francisco, Sept. 25-30. Papers are solicited on space vehicle communications, satellite instrumentation, data processing and new telemetry development. A 100-350 word abstract and a 900-word summary should be sent, with no later than May 10, to George L. Lewis, Lockheed Missile Systems Division, Sunnyvale, Calif.

► **Field Extension Cathode Ray Tube**—Feasibility of using a field extension cathode as an electron source for a cathode ray tube has been confirmed by study conducted by Lutful Rahman's Institute under Wright Air Development Center sponsorship. Report on research progress, identified PB 112746, can be obtained from Office of Technical Services, Dept. of Commerce, Washington 25, D. C., for \$1.00.

► **Signed On Dotted Line**—Major contract awards recently announced by various manufacturers include the following:

► **Tele-Dynamics, Inc.**, Philadelphia, will design a new high-speed system for rapid transmission of weather data under contract awarded by Air Force Cambridge Research Center. New system, called "Tele-Data-Link," will be able to transmit 10 frames in more than a second over same facilities as given, that the company says.

► **The W. L. Maxco Co.**, New York, \$250,000 contract from Bell Helicopter Corp. for development of helicopter landing system, known as HELP (Helicopter Electronic Landing Path) for use in all-weather conditions.

► **General Electric Defense Systems Dept.**, Syracuse, N. Y., three contracts totaling \$10 million, for ground based guidance system for Atlas, from Air Materiel Command's Ballistic Missile Center. Contracts cover work caused out under previous letter contracts.

There's NO ICING



MODEL 10470-C
engine, used in Beechcraft K21
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MODEL 10470-D
engine, used in Cessna 210-C
four engine executive aircraft.

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The engine using heated (separable from combustor type) atomized organic fuel when you fly with Continental Fuel Injection, for the refrigerating effect of vaporizing fuel at the carburetor is critical for atomizing the combustor itself. With Continental Fuel Injection, no combustor heat is ever required. You always use the coldest available air, for maximum power.

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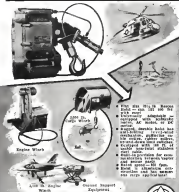
Petroleum Contracts

Following is a list of announced contracts for \$25,000 and over as ordered by the Military Petroleum Supply Agency in Washington, D.C.

Office supplies and ink, New York, per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
The Continental Paper Mills, New York City, per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
Nashua Refining, Inc., Houston, Tex., per lot #1, 2,000,000 gal. (1970-05-01), \$14,000.
New York, per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
Georgia Oil & Refining Co., Port Worth, Tex., per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
El Paso Natural Gas Products Co., El

From New York, per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
The Standard Oil Co. (Indiana), New York, per lot #1, 1,000,000 gal. (1970-05-01), \$14,000.
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29½ LBS. of Big LIFT! HAYDU RESCUE HOIST



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AT TAPCO...

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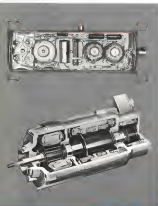
Your project may require microwave subsystems and components. Or a complete ground support check-out device. Or servo-controlled subsystems and components for a whole new vehicle concept. On each of these the Tapco Group can design, develop, and manufacture your requirements on schedule.

The Tapco Group is experienced in the design and manufacture of electronic controls, including closed-loop servo systems and components, monitoring controls, and small power-system alternators. Experience with microwave components includes coaxial and waveguide switches, power dividers, stripline microwave

filters, and microwave antennas.

Air-vehicle electronic systems developed by the Tapco Group include highly sensitive electro-mechanical controls capable of maintaining the speed of rotating electrical machines within plus or minus 1% in either parallel or isolated operation under widely varying loads, ambient temperatures, and vibration. Tapco-developed API speed controls provide an accuracy of one part in 100,000 (0.01%) under steady-state conditions.

At Tapco you'll find an unusual combination of electronic, electrical and mechanical skills ready to serve you.



API speed control system control and alternator built by Tapco Group for 3400/4000-cps surface air motor drive. Alternator with screw-type permanent magnets that are fully adjustable in air. Also incorporates unique flux-shifting generator for speed control.



ACE is high temperature (1000°) electronic controlling control system, designed for atmospheric tests control of thrust vector control for air vehicle.



Position control and speed servo in this Tapco-developed ground support unit provide computerized check-out of mobile guidance equipment, readily adaptable to advanced antenna positions and tracking systems.



Three models of Tapco-developed waveguide switches are used in radar search and missile systems. (a) Unique compact design features of rectangular waveguide search switch; full waveguide ports. (b) New design waveguide switch has ultra-compact dimensions in excess of 100:1. (c) Dual band waveguide switch has four-line waveguide structure.



Superconducting antenna system of ultra-compact design for long-range detection of missile launch systems. Tapco has developed the antenna system, antenna waveguide for S.T. Polysystems, Inc. for the Army, Dept. of Defense.



Highly sensitive sensing device developed and produced by Tapco Group for high-speed applications up to 100,000 cps. Design attributes used for design, testing, precision in grade, and complete field by all manufacturers.



TAPCO GROUP

Thompson Ramo Wooldridge Inc.

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DESIGNERS AND MANUFACTURERS OF SYSTEMS, SUBSYSTEMS AND COMPONENTS FOR THE AIRCRAFT, MISSILE, ORBITAL, ELECTRONIC AND NUCLEAR INDUSTRIES

Primary Standards Laboratory at TAPCO, where all secondary test equipment is calibrated at monthly intervals to ensure the accuracy of electronic products.



Electronics Research and Production Facilities at TAPCO

The combination of engineering and manufacturing capabilities represented in the \$160,000,000-per-year activities of the TAPCO Group provides an integrated capability of essential factors for the design and manufacture of electronic products. In addition, the electronic facilities and competence of the corporation's Ramo-Woolbridge Division are available to the TAPCO Group.

Our scientists and engineers can move rapidly on simultaneously-programmed projects. Analog and digital computers speed the design of electronic systems, then simulate their operation for test purposes. Components, electronic systems and subsystems designed in the TAPCO Group are produced within the Group.

Let us show you how we can design, develop, and manufacture electronic subsystems and components to meet your performance, reliability, and delivery requirements.



Production testing of electronic components at TAPCO.



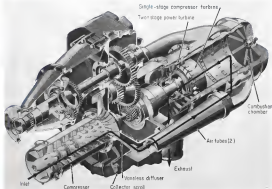
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ELECTRONIC AND NUCLEAR INDUSTRIES

AERONAUTICAL ENGINEERING



PRIMARY STRUCTURE of T63 is cast iron, which permits producing electronic assemblies and reduction gearing are built. Axial angles selected from compressor, gases through external tubes or into air tubes and then a single into single combustion chamber.

T63 Designed for Low Cost Production

By Erwin J. Bolton

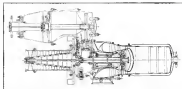
Concrete design approach is being combined with advanced manufacturing methods by engineers of Allison Division of General Motors Corp. in its new T63-type T63 series of gas turbine powerplants. Aim is to achieve low cost, light weight, simplicity and reliability.

Allison officials refuse to discuss possible price for production—the company will only say that it expects to sell the T63 series with piston engines of similar power—but industry sources estimate that the new engine will sell for somewhere between \$15,000 per horsepower, in production quantities.

These same sources also say that an important factor in the cost aspects of the engine will be Allison's use of plastic for many noncritical parts of the engine, including the compressor section. These plastics will not show up in

prototype models, but will be worked in during later phases of the engine's development. One clue seen in its current outline of the compressor section. The main axial stages are one piece,

entraps, stacked to form a complete assembly, rather than conventional build-up of a separate disk or disk and blades. These cannot react ratings are expected to be translated to plastic



DOWNWARD EXHAUST in order of engine is clearly shown in construction. This is T63 A1 propeller version, which reduces 6,000 shaft rpm to 1,000 rpm at propeller



CASE HISTORIES



Frequency Time Standard Instrument, selected by Smithsonian Institute for clock satellites, are equipped with New Departure ultra-precision ball bearings.

Photos: Courtesy from Norman Laboratories and Rudine Electric Co.

ND Ultra Precision Ball Bearings Help "Clock" A Satellite!

CUSTOMER PROBLEM:

Require ultra-precision bearing design for Rudine electric motor used in satellite-tracking macro-clock. Bearings must provide uniformly low starting torque, precise location of rotor shaft and minimum maintenance, to help mechanics achieve time determinations to 0.001 second.

SOLUTION:

N/D Sales Engineers studied special bearing requirements, and recommended New Departure ultra-precision ball bearings. These ball bearings measured up to every requirement for macro-clock motors . . . thanks to New Departure's advanced equipment for research, devel-

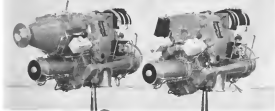
opment and production. N/D equipped macro-clocks, selected by the Smithsonian Institution, are operating in a dozen locations around the world right now, keeping track of vital satellite movements . . . to accuracies of one millionth of an inch!

If you're manufacturing or designing electric motors for any high precision applications, including instruments, why not call on New Departure? N/D engineering and research facilities are turning out the latest in high precision instrument ball bearings and advanced ball bearing designs. For more information write Department G-4.



DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

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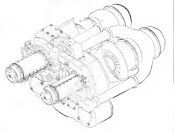
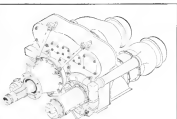
DESIGN PROBLEM as T53 was developing best wingroot of gear section and accessories, which built disproportionately large component in power-producing elements. Shows an alternate mixology of propeller-drive YT65A1 (left) and shaft-drive YT65A3.

applications in the later phases.

Two versions of the T53 are currently in development for the U.S. Army: a propeller-drive type designated YT65A1 and a shaft-power version designated YT65A3. Company model number is T53. Allison states that it never has no specific substitutions for the powerplant, but uses applications for both fixed-wing and rotor-wing aircraft, and also scout gliders and drones. The company expects that its agreements with the Army provide for producing conventional versions of the engine concerned, with various schedules. In addition to being a power source, the T53 is also used applicable to numerous utility functions, such as a turbine engine starter for nuclear propulsion and other portable power.

Current progress with the making of the first run of the engine this spring, with tentative development schedules calling for 10 hr. test in the latter part of 1960 and completion of T53's test and first production engines a year later.

Key men of T53 design approach were covered by Allison chief engineers Russell S. Hild during the Society of Automotive Engi-



REAR VIEW shows combustion chamber (bottom) on T53 wing.

TWIN DEVELOPMENT (Model T53) delivers 500 hp. Propeller-drive version is at top, shaft-drive type at bottom. Most components are of T53, new gear reduction is used.

ANOTHER REASON WHY ...

If it's Barber-Colman, it's better

**positive checking of high-speed air reversals
assured with these rugged pneumatic valves
featuring low leakage, low pressure drop**



1/4" Check Valve



3/8" Check Valve



1" Check Valve

Designed to check rapidly reversing, high temperature-high pressure air surges, Barber-Colman pressure check valves have been selected as equipment on many of the new jet airliners as well as military aircraft. In a typical application, the valve allows high temperature airflow into a wing thermal anti-icing manifold from an engine compressor bleed port. When pressure downstream from the valve exceeds that upstream, the valve prevents reverse airflow.

Of rugged, lightweight construction, Barber-Colman check valves have completed more than 10,000 surge cycles without appreciable wear. They pass 10-0 vibration.

Pressure drop is very low. For a typical 2 1/2" unit, total leakage does not exceed 0.1 pound per square foot for any combination of air temperature from 80°F to 1000°F and air pressure from

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In addition to those illustrated, other Barber-Colman check valves can be designed to your requirements. Consult the Barber-Colman field engineering office nearest you—New York, Los Angeles, Baltimore, Rockford, Ft. Worth, Seattle, Boston, Montreal. Or write direct for free Barber-Colman air valve catalog.

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AIR VALVES—A wide variety of electrically and pneumatically operated air valves for temperature and pressure-control applications. Relief, check, poppet, diaphragm, and automatic drain types.

ACTUATORS—Relief and Sense types featuring a wide range of gas reduction, cushioning and cushioning details. Available either in standard units or special design to fit various applications. Designed to applicable military specifications.

TEMPERATURE CONTROL AND POSITIONING SYSTEMS—Electric, pneumatic, hydraulic, or relay controlled systems designed to meet your requirements.

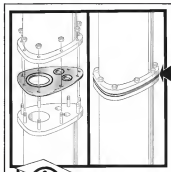
TRANSDUCERS AND THERMISTATS—Units for sensing temperature, differential, and total temperature. CISCAP system direct control temperature and/or airflow in ducts.

TEST EQUIPMENT—Compact electronic test sets for quickly checking all components of a Barber-Colman control system installed in an aircraft. Special units for checking many electrical systems.



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out!**



Hundreds of accidents have been caused by seals being left out during assembly or repair, and thousands of production hours have also been lost for the same reason. Just one of the plus values of Gask-O-Seals is that they are practically impossible to leave out because they are inspectable visually after assembly. This can mean many valuable money dollars saved, many hours of downtime saved—and it may mean the saving of human lives.

They also provide no-leakage positive sealing, prevent blow-outs. Damaging coldflow is eliminated, high manufacturing and maintenance machining costs are avoided and they are reusable. If you use static seals in your designs, why not find out about Gask-O-Seals—made by the makers of Parker O-rings.

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form along the flow direction in such tubes used to handle the well-defined speed boundary layer. Half sized. Also, due to the knots placed on the outside of combustors in such a small gas-turbine, compressor air must be collected in a small pipe in its passage to the combustors, be used. A centrifugal type rotor can be designed to occupy space required to deflect air to collector and achieve compactness.

To avoid undesirable stall effects, the centrifugal element of the compressor was finally designed with a number of vortex type diffusers.

Engine control system is simplest possible mechanical/hydraulic type or logic on the pilot whose position and changing electronic components complete. Pilot will control the engine by watching a turbine gas temperature indicator—in event of over-temperature operation on the engine. The pilot would adjust the throttle setting to bring temperature within limits. A torque indicator would be utilized in the pilot to avoid indicated limits, since the engine could run over 100 shp normally if allowed to go to full rated horsepower.

Helicopter rotor blades would provide connection of pilot's lever to the power turbine governor to permit selection of helicopter rotor speed. Normally, the lever would be moved to the maximum speed position so that the governor acts as an over-speed protection device. Since under this system the power governor would have input over the fuel control function, the gas generator will increase as decrease power are desired.

PRODUCTION BRIEFING

General Electric Co.'s Jet Engine Department, Cincinnati, Ohio, has awarded an \$8,385,660 Air Materiel Command contract for further development of the J93 diesel engine.

Terbo Dynamics Corp., Los Angeles and Minden, Nev., has signed an engineering of Submarine Propulsion Co. College Park, Md., as its subsidiary in its program of engines.

Martin Co. has received a \$7,400,000 USAF Air Materiel Command contract for expansion of the T37-700 Motor.

General Electric Co. has been awarded a \$7 million National Aeronautics and Space Administration contract for development and delivery of a liquid propellant rocket engine to power the second stage of the Project Vega vehicle (AVC Mar 7, p. 18). Engine will be a further development of the Vanguard first-stage propellant with an igniter nozzle designed for repeated starts at high altitude.



**CEC pickups
measure
airfoil pressures
to 5000 psi
...at 600°F.**

Testing the hot ones easy for rugged CEC Pressure Pickups... the 4-116A and 4-117, both designed for a wide range of pressure measurements at extremely high temperatures. Hundreds of these unique pickups were used to measure the dynamic and static pressure differential on various surfaces of the Convair 440 during the testing program for the nation's first supersonic bomber.

Designed for continuous operation at 600°F. without cooling, the 4-116A and 4-117 cover a pressure measurement range of 15 to 5000 psi gauge. Among their features: one-piece construction die casted from 416 stainless steel... 1/4" and 1/2" nominal diameters... weights of 35 and 15 grams with measuring flanges. They are widely used in fluid flow testing, engine studies and superconducting. When needed cooling is provided, an adapter extends the operating range of the 4-117 to 2000°F.

For additional information, call your nearest CEC dealer and receive offer or write for Bulletin CDC 1360-225 and 1368-136.

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First formation shot shows MiG-21 (NATO code-name Flamingo), latest Soviet design in MiG-series. Single nose air intake and large tailpipe surface indicate switch back to



Single large tail turbojet is 22,000 lb thrust class. Depth of wing sweep is increased over earlier MiG designs. Thrustjets first publicly flew in prototype form at 1956 Tushino air show, and are now in production. It is being jet-engineered into Soviet Air Force open closed units on key units. Speed is at 3,200 mph class with some versions reported to be fitted with a rocket motor boost for high altitude combat.



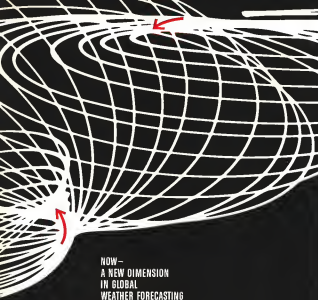
MiG-17 (NATO code-name Farmer) forms Yon (left above) shows modifications added to later models including addition of vertical fin on rear fuselage, spread tail-section wing panels on rear fuselage where often broken for the untethered flow tailpipe based on the British-made Nimble design in forward, and fuselage bulge over tail, possibly housing strengthened tailpipe controls. Note 37 mm. cannon protruding just below seat ejection on nose, internal fuel tanks, and three wing fences to improve climb rate flow across highly swept wing. MiG-17 is now standard operational fighter for Soviet satellite countries and is being phased out of Soviet Air Force front-line units. Top speed is about 700 mph. Closeup air-to-air photo (left) of MiG-17 fighter shows switch to forward fuselage stabilizer, reinforced tailpipe for true-vortex circulation, single large wing fence.

Formations

Show Design Details of Operational Soviet Fighters



Scramble takeoff is made by MiG-19 (NATO code-name Farmer) at an operational Krasnoyarsk airfield. Note leading gear retracting and relatively small tailpipe diameter as contrast to main fuselage diameter. MiG-19 is now standard first line Soviet Air Force fighter with top speed around 1,800 mph, and service ceiling of 60,000 ft. MiG-19 has combination of air-balanced seat systems and modern risk systems on fuselage. Aircraft has two small diameter, high thrust solid-flow turbojets of about 5,000 lb thrust each, dual air intake and tailpipe.



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Burroughs Corporation

"NEW DIMENSIONS" in computation for military operations



TEST jet engine in the U. S. operated solely on nuclear power was the General Electric X-46, a modified J47. Main modifications to the two axles replacing the combustion chamber to drive air in and force the nuclear reactor located at the side of the engine.

Part II: Nuclear Aircraft Program

Scientists Aim at Nuclear Plane Test Data

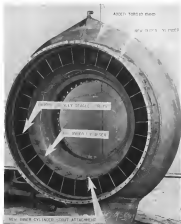
By J. S. Butts, Jr.

Washington—Feasibility of the principal systems and the broad design approaches needed for construction of a nuclear nuclear aircraft have been closely established during the eight years since applied research and development work was initiated in this field within the U. S.

Available data covering for these nuclear aircraft systems has been gathered primarily by experimentation and testing rather than through the development of exact theory which could be used to design the systems needed for any specific nuclear aircraft. Engineers are that such exact theory will not come for many years, if ever, and that nuclear aircraft design will be largely an empirical matter just as the design of non-nuclear aircraft is today.

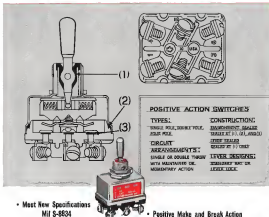
W. E. Edwards and J. E. McDonnell of General Electric Co., in discussing shield design in a recent technical paper, said, "Exact methods of shield analysis are not yet available. Perhaps computing machines available now or at least those available in the future will bring exact methods into the realm of feasibility. Even then, the accuracy of the methods will depend on the quality and quantity of basic data available."

So many variables affect these basic data that most authorities agree it will not be possible to develop exact shield design techniques for a number of years. However, General Electric and Lockheed, the two firms who probably have done the most work on the aircraft shielding problem, agree that it has been proven that empirical methods are adequate to produce shields



TURNING shield is typical of those which have been used on the aircraft deck members of the X-46 which have been tested. Approximately how through shields and engine is shown.

NEW Positive Action Switches for Aircraft, Missiles, Communications, Electronics



POSITIVE ACTION SWITCHES

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	TYPE-SEALED
	DESIGNED AT P.O. 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100
CIRCUIT ARRANGEMENTS:	LEVER-DESIGNED:
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Entirely new—designed and built to perform infallibly. These switches meet MII S-8834. They are available in the environment-sealed type, with new terminal seal, body seal and molded lever seal—and lever-sealed type, with molded lever seal only. Wiping contacts insure perfect switching for low energy circuits. Direct toggle-to-contact mechanism makes the switching action positive, insuring safe, reliable switching on high energy circuits.

One degree of lever throw opens the circuit. The

contacts make and break independent of any spring pressure. These switches have positive detent action—they cannot be tossed.

A new insulating material provides improved arc-quenching resistance and excellent voltage recovery. Staggered terminals permit maximum clearance for easier wiring. Circuit arrangements are unlimited. Available with either standard toggle lever or new lever lock. Write for literature KA166-G-294. Cutler-Hammer Inc., Milwaukee 1, Wisconsin.



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light enough for use on subsonic aircraft which gross around 200,000 lb., may later package than conventional aircraft of the same size and allow greater than current utilization of flight time.

Some statements have been made about the adequacy of present weapon design methods for the other system needed for a nuclear aircraft. The time required to build and flight test a subsonic nuclear aircraft using these methods is estimated by Atomic Energy Commission and Air Force, estimates of somewhere between three and five years (AW May 30 p. 55).

Completion of papers presented on nuclear aircraft shows that many of the design approaches to these two critical problems are already being more fully defined.

- Reactor and engine.
- Shielding.
- Materials.
- Ground handling and maintenance.

Type of nuclear turbine is the great unknown state in the U.S. in the direct cycle with the engine air passing through the reactor to cool the turbine as well as to provide thrust. This type of engine has been in development for eight years by General Electric, which has run a modified J47, designated the X79, for 100 hr. on reactor power alone.

Several reactors have been run in combination with various ducts around the X-79 during the General Electric experiment at the AEC test site at Idaho Falls, Idaho. The reactors had all been placed to the side of the turbojet so that considerable redesign was necessary to convert the J47 to the X-79.

First problem was the much higher pressure drop through the reactor and in connecting piping than had existed on the turbojet using a chemical fuel burner system. This left the compressor and the turbine in a badly mismatched condition. To solve this problem, centrifugal compressor was substituted to supply less air than in the original design.

Two scrolls also were designed, one to diffuse the compressor air to the fuel exchange system and one to send the air back into the turbine. These scrolls are unmanufactured and therefore unique among several turbojet components, and they have unusual problems in vibrational motion which has not yet been worked theoretically. Model testing is the only design approach now available for these scrolls. Extensive hope is to be able to reduce the diameter of the scroll and its housing shaft to a small enough figure to fit into the turbojet and eliminate the side position of the heat source and the need for scrolls.

Two other major problems with



OPERATING the "Hardyman" manipulator, project engineer Ralph Moker places his hands in gloves which put pressure on his fingers, giving him a "feel" for work he is performing.



MANIPULATOR equippings outside carrying planes. Their dimensional index TV camera (below) gives remote control engine mechanics a view in depth to control "Hardyman."





MOMENT IN HISTORY

THIS IS THE "FIRST FLIGHT"
of the new Air Force TITAN,
America's most powerful weapon and
our No. 1 challenger in the big missile
fold. Time: 11:03—4 M p. EST.

The most important thing about
this moment in history is not
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Three years to the
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at Martin-Denver, TITAN No. 1 roared
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and the creation of the free world's
most advanced ballistic missile
family—and the development,
production, testing, delivery and
launching of the first of an entirely
new generation of ballistic
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TITAN is the
result of an enormous engineering
savvy—developed by Martin under
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of the Air Research and Development
Command—which provides the
most extensive pre-flight testing of
components, subassemblies and full
scale missiles ever undertaken.

This method in
the TITAN development,
and in the generation of space
systems to follow, may well
be one of the most important single
factors in speeding America's
bid for space supremacy.

Martin-Denver
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of The Martin Company



these solids in their tendency toward
uneven pressure distribution and high
temperature spots.

Design of small high power density
reactors such as the type needed for the
satellite missile is involved and dependent
upon a number of variables. Basically,
the satellite reactor being developed
today is about 4 ft. in diameter
and approximately 6 ft. long.

They must be kept small in order to
reduce shielding weight, keep pressure
losses low and in spaces at highest
possible temperature and require least
transfer between the reactor and the
engine unit.

Fuel elements and their placement in
the reactor must be handled with great
care if the efficiency of the system is
going to be high enough for flight use.
The power distribution across the reactor
core and the specific elements should
be well known, and, lengthwise, it
should be peaked toward the forward
end of the core to get the maximum
efficiency.

Two general methods have been tried
to achieve these power profiles—adjust-
ing the placement and amount of fuel
in the specific elements and carrying the
spacing between the elements.

The air space between the fuel ele-
ments greatly complicates the job of
detectors using the criticality of the reactor,
because they are separated by air space
and are, therefore, somewhat self-shield-
ing. This also raises the size of the
overall unit. Neutrons also tend to
stream out of the reactor in the air
space and upset manual calculations
in determining the criticality and reactan-
ces of the reactor.

Used types of reactor materials have
proven to have mixed blessings for sat-
ellite use. For instance, graphite which
is a good material for neutron reflec-
tion, gives a very bad power peak in the
extremest tubes of a heat exchanger
reactor. This can only be corrected by



SCHEMATIC of the test rig for opening
fuel tubes on atomic power for the satellite
is very large vessel with much more shield-
ing than is needed for the divided shielding
needed in an aircraft.

the SWALLOW

Republic's

answer to the pentomic army's vital need

Completely integrated for airborne targeting and surveillance, the Swallow will provide at Army Corps and Division levels, a system capable of rapidly and accurately pinpointing enemy target positions. The system achieves full battlefield effectiveness for the new family of Army weapons.

The Swallow, designed with a high degree of mobility, is capable of keeping step with the exacting concepts of the fast-moving, hard-hitting Pentomic Army. The performance requirements have been established to insure maximum survival and minimum costs of system operation.

Republic Aviation Corporation has the complete systems responsibility for the Swallow development, working in close cooperation with U. S. Army Signal Corps Research and Development Laboratories at Fort Monmouth, N. J. and the Army Combat Surveillance Agency, Arlington, Va.

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CERAMIC control circuit components are used in solid-state and high-temperature resistant amplifier chains. Work with such units has proven the feasibility of electronic equipment in controls area control.

an optimal adjustment of the fuel distribution.

Control of the reactor and its byproducts is simplified, according to General Electric, so that the pilot of a nuclear aircraft will have powerplant controls similar to those on a conventional jet engine. The reactor will have a number of control rods which will be carefully withdrawn during the starting period. Starting period still partially will be automatically controlled and rather lengthy.

Fewer Cams

After the start, the power curve will flatten out for most reactors and suffer rapid changes in power will be possible. Though these power changes will not be quick as noted in that possible with chemical fuel turbojets, they, probably will be as rapid as the engine's rotating machinery can take. This may eliminate compressor stall, surge, etc. Acceleration characteristics of the nuclear aircraft would then be somewhat more than those of present day turbojets.

Several automatic systems and their necessary sensing elements which may make it possible to control the reactor from the control of the reactor. Perhaps have been studied at length by General Electric. Basic components of these systems are actively cooled elements or rods, thermal and nuclear sensors and actuators. All of these components will have to function in a high radiation field near the reactor, and, during the start-up phase, it has been proven by General Electric that such components can be built with a satisfactory service life.

Probable time sets of instrumentation will be necessary to precisely monitor the nuclear activity of the reactor. The first will be needed during the starting period when the reactor activity is usually, another will be needed at the end of the starting period when rapid power changes are taking place, the third will take over when the reactor is at the power step and ready for flight.

Automatic systems which will be used

to control the nuclear powerplant have two main functions—to keep the power level of the reactor nearly equal to the demand level and to keep the multiplication factor at approximately unity. The multiplication factor also is called the reactivity, and it is determined by the position of the control rods which act the rate at which power may be increased. When a reactor is used in connection with a turbojet engine, this multiplication factor must be close to unity for rapid increases in power cannot be achieved by sudden large increases in the air flow needed to keep the reactor at its prescribed operating temperature.

Flight Monitoring

On the nuclear aircraft as it is now planned, the flight engineer will monitor the reactor constantly so that he can instantly take control in the event of a malfunction of an automatic control. It has been determined in tests that both the automatic and manual systems are practical.

The only airborne skidding development work conducted in the U. S. that far has been handled by Convair. A 1,600-hp. reactor now flown in a modified D-56 designed so that it was possible to evaluate 25 different combinations of ducted ducting. Tests showed that one of the best tests for reducing skidding weight is to divide it between the reactor and the flight crew's compartment.

D-56 hybrid was protected by ducting consisting of layers of rubber and lead. The lead thickness varied from 1.5 to 2.5 in. and the rubber from seven to 17 in. Only the planes were provided with windows. These windows were not more than 11 in. thick and covered from Plexiglas and leaded glass. Behind the flight crew compartment there was a half-inch lead shield which could be raised in competition. Be-



OAK RIDGE test setup shows how used to indicate a complete jet engine test determine the nature and life of various fuels and the length of the cooling period necessary before direct measurements could be performed. Reactor is in rear of right.



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such as plows, cultivators, and disc harrows. This cylinder uses your Hadley Stainless Mechanical Tubing with the I.D. bored to size and roller burnished to a finish of approximately six to eight RMS. The expected life of this cylinder is in excess of 300,000 cycles, operating at 1,500 psi hydraulic pressure.

"The other cylinder is furnished to another one of our customers, and is a 5 1/4" I.D. double-action cylinder with a 15" stroke. Used to raise and lower the platform of their self-propelled combine, it is similar to the actuator cylinder



with respect to finish requirements and material for the barrel. The operating pressure is approximately the same and so is the expected service life of five years, or 300,000 cycles. Generally these cylinders may be serviced for additional use by merely replacing the seals.

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WORLDS largest nozzle, according to General Electric, built to allow close view of rocket and adaptors in operation.

from this scaled-down size component and the reactor, it was possible to try several varieties of shield shields. These small shield shields suggested that shield tanks around the reactor. There was one of these shield tanks which could be tilted in various combinations.

Positive value of this shield tank was to isolate the effects of an atomic and neutron source on the radiation pattern from the reactor. In 24, 47 flights were made with this source to gather radiation data. They ended in March 1957.

Further investigation to determine the effects of the radiation system provided by the reactor of the B-50 was conducted here at Oak Ridge. There, the test reactor and the crew compartment were suspended from 100 ft towers in the same relative position they had occupied in the aircraft, and the status of shielding arrangements were tested again.

When the shielding is placed near the reactor, it will tend to the point where the shielding passages will have to be provided in the shield to keep it sealed over a long period of time.

In general, shield design began with the setting of the reactor due to the fact that will be allowed in the case and that which one is permitted to study the various parts of the reactor. Addressing the weight of the shield around the core and the reactor will control these design.

It was found through the Cassini flight tests and through ground experiments that geometry is one of the most important design parameters for effective shields. Through geometry control it has proven possible to reduce the neutron streaming toward the reactor to great advantage in reducing the level of the radiation reaching the crew compartment and other portions of the aircraft structure.

General handling and maintenance has been one of the principal problems concerning the nuclear reactor, and on

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MATERIALS Testing Laboratory at Idaho Falls is typical of a number which are available in U.S. for testing often of stress conditions on aircraft materials systems.

who cannot it requires more conventional procedures than it does in the air.

First of all, there must be a completely remote-controlled method for controlling and measuring the reactor on the ground if it is to be possible to perform major maintenance on a nuclear aircraft that has completed a long mission.

This reactor, which has been producing power for a long period, also will require a system of shielding which will have to remove considerable quantities of heat.

It was demonstrated by General with the B-76 modified for nuclear tests that it was possible to accomplish this remote removal and distribution of a waste.

Probably the most difficult part of the maintenance work on a nuclear aircraft will be on the nuclear engine which will be subjected after a long flight to the point where it will not be able to work in direct contact with them for a considerable period of time after landing. Test work has shown that engine maintenance will be more conventional after the reactor, engine and nuclear shielding have been removed. After a short cooling period it is believed that it will be possible to work in direct contact with the engine.

Most of the devices and installations needed to accomplish all of the remote-controlled maintenance and ground handling which will be required by its reactor powerplant already have been designed and constructed by General Electric. In many cases, these devices and installations represent considerable

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COMMUNICATION SYSTEMS

that resist nuclear radiation

Positive and reliable communications are the lifelines of new strategic weapons, hypersonic aircraft, satellites, and air defense. Resistance to nuclear radiation damage is an additional prerequisite for some of these advanced weapons systems.

The Bendix Systems Division, using the Ford Nuclear Reactor at the nearby University of Michigan, is developing radiation-resistant Mission and Traffic Control equipment. This work is being conducted by Bendix as a contractor to the Air Force. The objective is an M&TC subsystem providing extreme reliability under severe environmental conditions and over long operating periods.

Hypersonic aircraft and re-entry vehicles require that communications overcome the attenuation of surrounding ionized air. Bendix is carrying out

propagation investigations and experimenting with designing special digital and voice communication systems. This work is under way at the Systems Division, Radio Division, and Pacific Division of the Bendix Aviation Corporation.

Positive communications also require resistance to jamming. Advanced research at the Bendix Systems Division has evolved techniques that combine jamming resistance and security of transmission.

Advanced communications know-how is being applied to additional programs for which the Systems Division has system management and engineering responsibility—such as the Navy EAGLE System and the Air Force AN/AMQ-15 Weather Reconnaissance System—and is applicable to many others.

Bendix Systems Division

AND AERIAL RESEARCH



Paul Walker, Director of the University of Michigan

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For more information please write to: Mr. A. B. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
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ness and carrying 12 persons now, soon to transport the test rig on blisks from the test area two miles down the track to the shielded maintenance shop. This sensitive vehicle would be used to transport a nuclear bomb after a flight from the end of the runway into a large concrete maintenance hangar. The aircraft would be run up on a low flat car on tracks and then pushed by the test rig.

Two major missile handling cranes needed for the usual operation of a nuclear aircraft have been designed but not constructed. They are:

• Large overhead hanger with shrouded arms for the removal and storage of highly radioactive stores and normal aerospace maintenance.

• Self-propelled, shielded vehicle with emergency arms to perform some of the required assembly and disassembly of the reactor and shielding equipment just after loading. This vehicle would be very heavy because it would carry 75,000 lb. of lead and steel shielding against gamma radiation. Motion thus becomes extremely small as soon as the reactor is shut down.

Long Utilization

Principal reason why long utilization is desirable is to concentrate aircraft and shield better. Such facilities experience in the past is being predicted for the nuclear aircraft in that flights will last approximately one week and that only about 15 a year would have to be made to reach this utilization figure.

Past experience has also shown that systems on the nuclear aircraft probably will be more reliable than those on conventional aircraft because they will operate under steady state conditions for much longer periods. Failure rate of complex mechanisms has been shown to be dependent on the number of operation cycles performed rather than the number of hours of steady state operation.

More reliable facility for the experimental study of the effects of nuclear facilities on aircraft systems and assemblies is being constructed for the Air Force by Lockheed in the North Georgia mountains. This facility allows the simultaneous radiation of an aircraft-like load of material. A large reactor has been placed on an elevator so that it can be moved from its normal position at the bottom of a shielded pit filled with water to irradiate the test specimens. After they have been exposed for the proper length of time the reactor is lowered and the irradiated area is automatically released so that they will roll away to a safe location where they can cool off and then be transported by normal means to an inspection laboratory. U.S. Air Force Priority consideration of the materials

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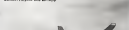
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work which has been done in date in that it will be possible to build a subsonic nacelle without having to enter the realm of new aerodynamic and design materials are most difficult to achieve because they are damaged by both moisture and general use. Both of these types of solutions, which are the major ones coming from a fusion of active, passive structural and aerodynamic ideas, which by their nature, is to arrange their bonds to make the new materials and easily form a new material with new chemical properties. Long-term studies are such as to study the organic materials. Damage to the organic materials is due primarily to moisture action alone. This damage is in the basic crystalline structure, with the moisture bonding atoms from their place in the lattice. This causes changes in electrical, structural and thermal properties.

Two basic factors work in favor of using long-term materials in high temperature areas and at high temperatures. First, the damage is proportional to moisture damage only up to a certain point. After that, there begins to get knocked back into their proper state. There is a continuous degradation that can occur, depending on the material. Second, high temperature has the effect of speeding up during the moisture damage because at the temperature is increased, the atomic vibration and migration is increased and there are allowed to return their normal position.

(This is the second of two articles dealing with the technical feasibility of a subsonic nacelle aircraft. First article appeared in Aviation Week on May 30, p. 30.)

AMC Contracts

Wright Patterson AFB, Ohio—Following is a list of unadvertised contracts for \$25,000 and over as released by the Air Materiel Command.

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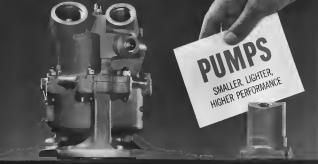
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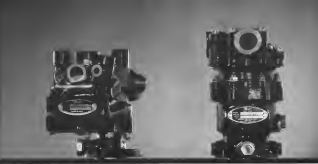
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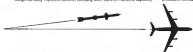
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ductum effectively moved machinery, rough blocks under little or no pressure and separating the finished parts to long periods of heat treating. Finally, repair is a minimum of machining.

The berillium forging process was developed at Wyman-Gordon as part of a company-financed research project. Details of the closed-die process were not disclosed. Wyman-Gordon is investigating the possibility of patents.

The company did reveal that amorphous-grade berillium powder obtained from the Beryllium Corp. was forged in an 18,000-ton forging press. Oxidation is prevented by either a protective atmosphere or vacuum method.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

A Proposed Mechanism for the Strengthening of Sup-TYPE Alloys—by G. S. Ansel, Naval Research Laboratories, Detrick, 1973. \$ 50, 4 pages (PB 151047).

The Properties of Temperate Corrosion-Resistant Composites of High Density and High Hardness—by F. A. Kahn and N. S. Jellin, Western Aeronaut Laboratories, U. S. Army, Dayton, 1973. \$ 25, 56 pages (PB 151047).

Investigation of a Method for the Measurement of Subsonic Oscillations Aerodynamic Laboratory—Coordinators: R. N. Abramson and P. A. Beckman, Jr., Southwest Research Institute, Inc., Wright Air Development Center, U. S. Air Force, Dayton, 1973. \$2.00, 75 pages (PB 151049).

Drag Due to Tail of a Not-So-Slimmer Configuration—by H. K. Chang, Corbett Aeronautical Laboratory, Inc., Wright Air Development Center, U. S. Air Force, Dayton, 1973. \$1.25, 46 pages (PB 151051).

Impossible Friction Factor, Transition and Hydrodynamic Boundary Length Studies of Ducts With Triangular and Rectangular Cross-Sections—by E. R. G. Eckert and T. F. Irvine, Jr., University of Minnesota for Wright Air Development Center, USAF, April, 1957. \$6.25, 36 pages (PB 151771).

Chemical Resistance and Thermal Stability of Fluorocarbon Elastomers—S. Wilson, C. B. Griffin, and J. C. Montanano, U. S. Army, December, 1957. \$7.75, 33 pages (PB 151947).

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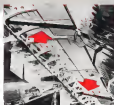
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For details about these positions (from Mr. R. A. D. Stevens, Engineering Pool, North American Aviation, Inc., Los Angeles 45, California).

THE LOS ANGELES DIVISION OF
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Chance Vought Aims at Diversification

By Craig Lewis

Dollar-Sponsored by recent contract cancellations and backed by high current sales levels, Chance Vought Aircraft Inc., is working hard to reshape itself as a more diversified company with a broader market base.

Over the past year or so, Chance Vought has taken a number of steps in management and technical areas which point toward diversification and new markets. These efforts were given new impetus when the Navy cancelled the BMS-3 and Regulus II program in December, but Chance Vought had been on the move long before these projects were lost.

Like other aircraft manufacturers, Chance Vought is hard with a rapidly changing military market in which high complex systems are bought in small numbers and where production of large production runs by a variety of military aircraft are rapidly becoming fewer.

Along with this general situation, Chance Vought has the added problem of being a company with a single traditional customer—the Navy. Thus the company is working on broadening its activities within a new military market and to new civilian markets.

Despite the heavy blows of the December contract cancellations, Chance Vought had the best year in its history in 1958. Sales rose, \$115,792,412, up sharply from the \$20,392,178 figure for 1957 and earnings after taxes rose from \$6,132,183 in 1957 to \$9,007,626 last year. The company distributed \$2,475,146 in dividends in 1958 and closed up the year with net working capital of \$37,981,514. Earnings amounted to \$7.55 per share.

Chance Vought's earnings of \$6,636,090 worth of convertible debentures for stock in 1958, leaving debentures totaling \$8,824,000 at year end. During the year the company expanded its line of bank credit to \$34 million with borrowings totaling \$19 million at the end of December.

With this record for 1958, and with business contracting at a high level in 1959, Chance Vought is in good financial shape to support its diversification effort.

The main area where the demand is dropping is the present year is in military orders. Backing is down sharply from \$676 million at the end of 1957 to \$170 million at the end of last year, and that is where a good



CHANCE VUGHT Aircraft's engine ramp ramp has produced the 21-month work can be worked as continuously, each position has compressed as orders for engine starting. These as engines are loaded next to larger at top left. Data Stack stand represents in it top center, with PUG-2 Crusader pulled nearby. Seventh on the line are PUG-1s, with a single PUG-1P. Note jet fuel detectors.

part of the damage from the cancellations has. Dollars cancelled were worth about \$110 million.

Both of the programs cancelled would have added to production volume, this year but, more important, they were advanced weapons systems with production runs which were likely to stretch beyond the Crusader fighter series now in production. Employment dropped from an average level of 36,606 during 1958 to 31,708 at year end with the layoffs translated in the last two weeks of December following the cancellations.

Several limited new ventures have been released since Jan. 1, and the impact has been spread through production, engineering and tooling personnel, although the bulk of the layoffs were from the production force.

The PUG-3 was the only production engine and would have been building up five year, adding to current production work and providing a product that would be produced after the current Crusader series phased out. In contrast, the Regulus II was much closer to maturity and would have produced at about the level it had reached

Another item moving from the production line was the Regulus I.

This program was phased out in completed in December after Chance Vought had built 516 of the aircraft. This leaves 1959 business volume, at most totally dependent on the Crusader series fighters—the PUG-1, PUG-1P, PUG-2 day fighters and photoflash, and the PUG-2N, an advanced version with limited air-to-air capability.

With the Crusader production now scheduled, Chance Vought expects to have the second best year in its history.

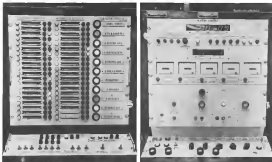
That means sales somewhere between last year's \$115 million and the \$175 million earned in 1957. Crusader production is expected to last through 1964, although the production run will be decreasing as the fighter series moves toward obsolescence.

Chance Vought is working on pilot capsule and bomber factors aspects of the Deuce-4 program as a branch of the Boeing Airplane Co. from which it could furnish future business if the Air Force picks the Boeing team for the job. The company also has a subsonic trainer to build and systems for the North American B-70. This work is largely



Concrete Mockhouse at The Martin Co. in Denver houses test facility for Titan intercontinental ballistic missile contains master operators control console (left), panel at left is for video system control, one at extreme right is vector panel. At right is commander's separate unit.

Operations Console Controls 200 Titan Functions



Group of function and system status panel (above, left) shows read stations, ranging from "on load left" to "on time." Lights and indicator status of the function. At right the countdown time indicator is shown in top window in red. Second window indicates malfunction.

Master sequence control operator (below, left) pushes in a countdown on the master sequence program board. About 200 functions can be checked. At right, console operator checks the vector panel. Operator can lose all countdown but must press button to toll.



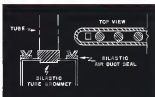
The PLANE

America's newest production bomber, the Convair B-58 Hustler. This delta-wing jet employs an area-ruled fuselage for supersonic response efficiency, and has reportedly been flown in excess of Mach 3 at 53,600 feet. Engines are four J-79's, in pods below the wings.



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in engineering, new tool building and production will start to place its bets in the year.

Chrysler President Fred G. Deuker told Aviation Week his company wanted to be Regular II and 1963.5 modelships to reach the new future that it cost similar situation in the past. "We put a lot of people on the road looking for new business," he said, just as Chrysler Vaught did in 1959 when the A20-1 was created. At that time the company watched for subcontract work and engineering studies. Research and development work was increased and the engineering organization was backed up.

After the 1954 modelships, Chrysler Vaught started working on its design solution program, and the modelships late in 1955 added new aspects to this program and indicated future decisions on business planning. Deuker said they "took two or three years of constant focus out of our future planning."

Shaping on Image

Chrysler Vaught has been a separate corporation since it was spun off from United Aircraft in 1955, and the company has been slowly shaping a new, independent image for itself ever then. This has amounted to a step by step orientation "to our view of the future." Deuker said, and in raising the future, it seemed a good idea to look out of the speed rate as a supplier of Navy aircraft and to be durable, especially in the changing market of the past few years.

In 1957, operations were broken down under four vice-presidents—engineering, production, development, and sales and service. Then in 1975, Clifford E. Butts shifted from the job of vice president and controller to the new job of vice president finance. Later last year the division reported a new management organization in which Vice President Engineering Raymond C. Maylock became vice president and general manager. Vice President Production Clifford K. Johnson became vice president for business planning, and Sales and Service Vice President W. Paul Dwyer became vice president in charge of the Washington office and all foreign sales.

With these changes, Chrysler Vaught's top management is fixed from outside regarding to concentrate on broad corporate matters and on the push for new business and new contracts.

Part of the search for new business lies in the increasingly competitive subcontracting field. In the past Chrysler Vaught has never had more than 10% of its sales in subcontracting and Deuker doesn't expect it ever to go over that level. He said that subcontracting

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Most important requirement for these positions is versatility — that blending of education and experience which equips engineers to think in terms of hardware under field test conditions. An engineering degree and missile test experience are most desirable, but a sound background in related work can furnish the necessary qualifications. Specific requirements are in **ELECTRONICS** (R.F. communications, instrumentation, servo control and guidance systems) **MECHANICAL ENGINEERING** (pneumatics, hydraulics, propellant handling and loading, mechanical ground support equipment), and **CIVIL ENGINEERING** (establishment of design criteria at missile facilities). There are also outstanding opportunities for **ENGINEERS AND SCIENTISTS** in many other areas and at all levels for a variety of space programs under way at Convair-Astronautics' San Diego headquarters. Our engineering representatives will be conducting **INTERVIEWS**

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will never be a major portion of sales. Detectors point out, however, that the detection of subminiaturizing gets lower when such things as external work, structural work and parts of test programs are involved. It definitely does not include major participation such as Chance Vought's D-5600 work, in the 10% top estimate for subminiaturizing.

While management recognition has been shifting, some changes have taken place in the company's technical engineering which mark a trend toward product line groupings. An electronics department has been established to handle electronic work by Chance Vought's current programs and to furnish support for subcontractors into new fields. An auto-instrumentation group has been set up to explore that solid problem area. A range system division was established to exploit Kepler instruments and but for work on the burgeoning market stemming from test projects in the Pacific Missile Range and a new Army stage at Ft. Hockley. While these activities and others develop prospects for new business, they also furnish work for valuable technical personnel Chance Vought wants to keep.

With this orientation toward product line groupings, one of these integrated groups could be lifted out of the present organization here and established as a separate operating division any time business shifted toward such a move.

Broadened Market Sought

Chance Vought has led in various Mars, Air Force and Army competitions in an effort to broaden its market. Last year the company took the somewhat unusual step of developing a missile with its own funds as a candidate for the Army's new family of battlefield missiles. Work was started in July, and test firings were made at Robinsome Arsenal early this year. The missile is powered by anhydrous nitric oxide motor, rather than the Robinsome personnel expected earlier.

Chance Vought built the missile with its own money to reinforce its bid because this was its first subminiaturized effort with the Army and the company wanted to make an impact beyond the usual bidding process.

Some commercial business is also considered desirable although the company has set no definite goals at Robinsome. Detectors told Aerospace Week that "business is not one" and Chance Vought will find its way along in the goal in the commercial field, sitting for whatever size of subminiaturized business develops.

Detectors expect commercial business to be in keeping with the company's capabilities and the more products which are built complex technically. No commercial products are

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(Continued from page 23)

Changes

Robert F. Gorman, director of engineering and sales, Spray Coatings Co.'s Air Assessment Division, Great Neck, N. Y. Other Air Assessment appointments are: **George E. Wright**, manager customer affairs; **John K. Ensign**, engineering manager; **Robert E. Wondt**, manager, sales and administration.

Charles E. O'Holmes, manager operations planning and control, Research Gyroscopes Co., Santa Monica, Calif.
Raymond L. Kline, manager production relations department, Magnesium Aircraft Co.'s Ogden, Utah Division.

Jack Gary, senior contract administrator, Taconic Aircraft Corp., Dallas, Tex., seconding **Howard Clark**, cost estimator manager on the Corns missile program.

Bert G. Bellon, assistant to the vice president of the Patent Engineering Division and the West Coast office, U. S. Pat. & Atlantic Research Corp., Alexandria, Va.
Paul F. Gorman, director of industrial engineering, Thompson Radio Woolsdale, Inc., Cleveland, Ohio.

Robert W. McLeod, general sales manager, Koolhaer Aircraft Products Co., Inc., Dayton, Ohio.

Albert M. Yates, manager military tests and sales, Goodway Limited, Vancouver, Canada. Also **David W. H. Coffey**, assistant manager of information services.

Carole K. Taylor, district manager of the West N. Y. office of the Microwave Division of Brinnberg-Carlson, a division of General Dynamics Corp.

Ann Smith, director of research and development, Gladding Division of U. S. Industries, Inc., Chicago, Ill.

U. Victor Turner, manager of scientific testing, Data-Control Systems, Inc., Des Moines, Iowa.

John K. Wertheimer, chief, Systems Engineering Division, Radio-Metallurgical Inc., Columbia, Ohio.

James R. Becker, motion sales manager, and **Scott H. Harville, Jr.**, manager special sales engineering, Jack & Harris, Inc., Cleveland, Ohio.

Paul P. Deane, chief engineer, Hydrex Corp., Los Angeles, Calif.

Ed. G. David L. Perry, USAF, Lt. J. derivative of aerospace development, Charles Luskman Associates, Los Angeles, Calif.

Bligh C. Bissell, manager Santa Barbara Division, Hughes Aircraft, Watsonville, Calif.

U. S. Industries, Inc., Santa Barbara, Calif. Also **Douglas Elliott**, senior technical engineer, **William S. Deaky**, project manager underwriter detection and radio-detecting system programs, and development of special test equipment.

Leo F. Prosser, corporate director of advertising, Pacific American Corp., San Francisco, Calif.

William R. Korman, manager of reliability engineering, and **W. S. Crawford**, packaging engineer, Tridwell Products Division, Packwell Field Electronics Corp., Los Angeles.

Dr. Victor Parady, laboratory consultant, Electronic Defense Laboratory, Belmont Aircraft Products, Inc., Mountain View, Calif.

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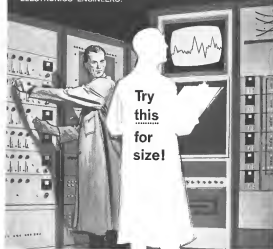
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* U.S. Patent No. 2,568,372